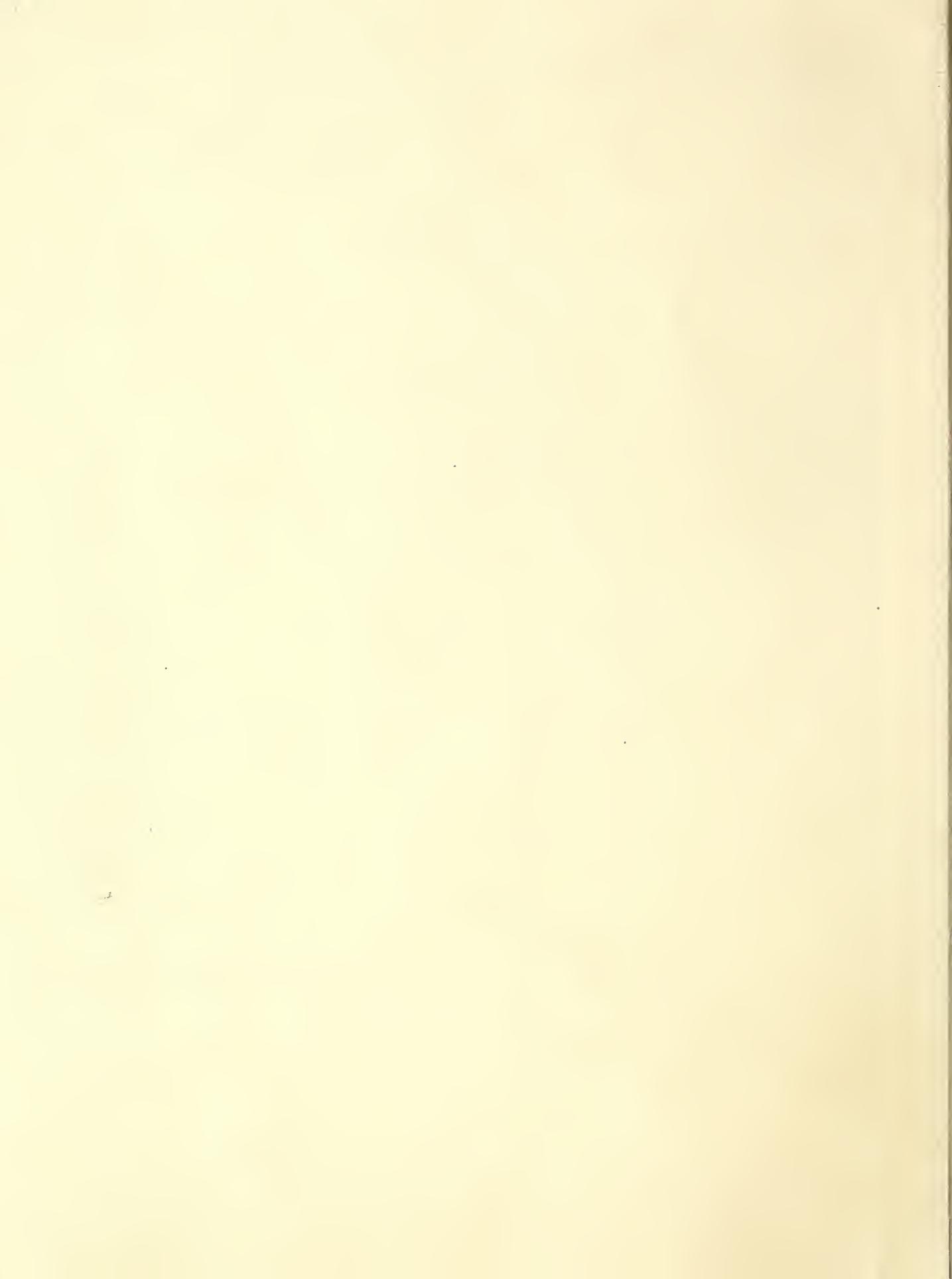


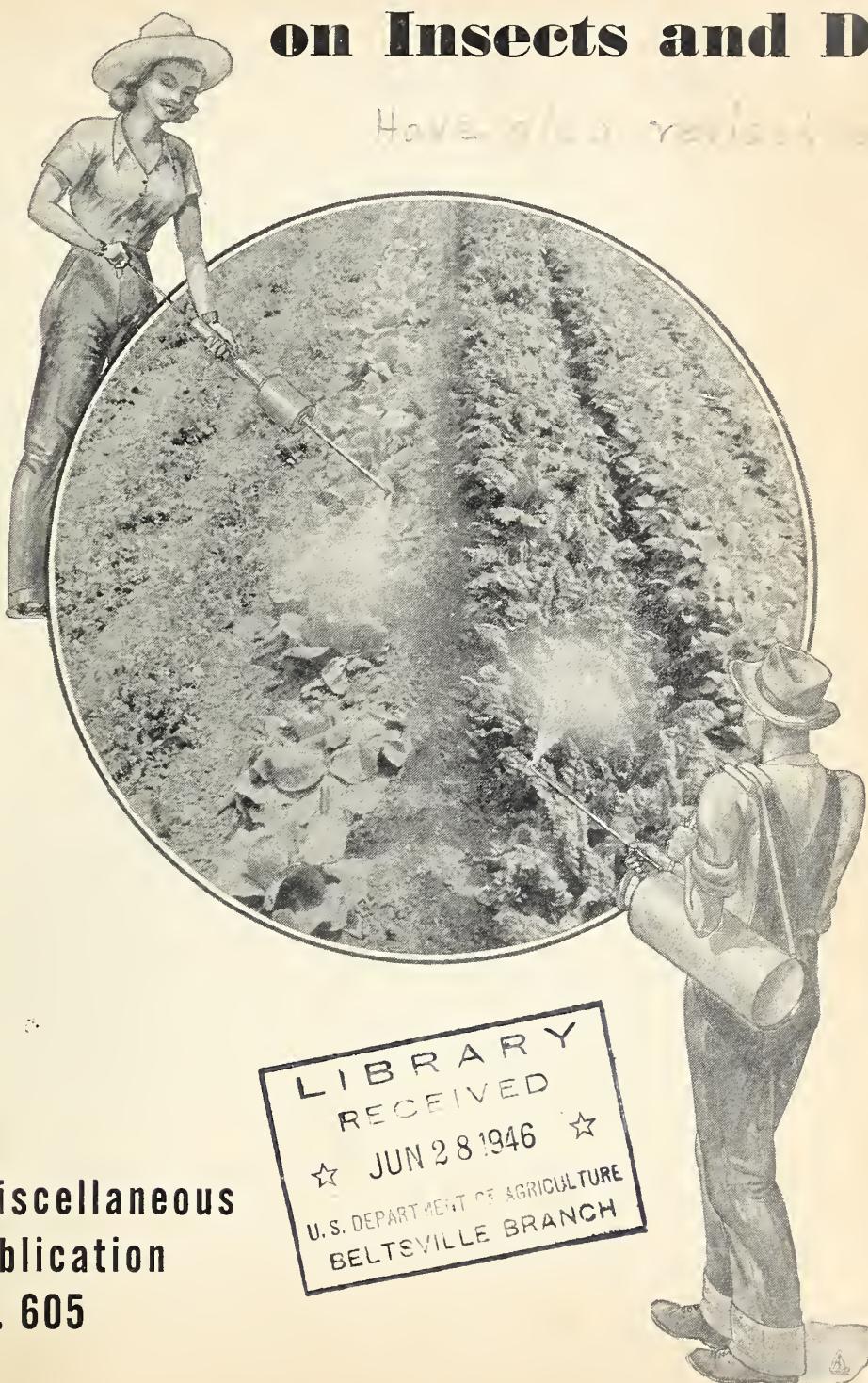
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A Vegetable Gardener's Handbook on Insects and Diseases

Have also revised, etc.



Miscellaneous
Publication
No. 605



UNITED STATES DEPARTMENT OF AGRICULTURE

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THIS PUBLICATION has been prepared to aid the gardener in identifying the more common insects and related forms and the more common diseases that attack vegetable gardens in the United States and to provide him with simple directions for the control of these pests.

In the space available in this publication it is impossible to give detailed recommendations for the control of the insects and diseases listed or to include information on additional insects and diseases which may be found locally in vegetable gardens in various parts of the country. An attempt has been made, moreover, to simplify the directions for the preparation and application of the insecticides and fungicides recommended. For this reason the sprays, dusts, solutions, and baits have been reduced to a minimum and made as uniform as possible, even though in some instances the directions given herein for the preparation of the small quantities of materials usually needed for vegetable gardens may not conform exactly to the directions in the more detailed publications of the Department.

The formulas and directions for preparing the insecticides and fungicides will be found on pages 24-28 of this publication. The chemical DDT (from the generic term dichloro-diphenyl-trichloroethane) has been developed in recent years and has come into extensive use as an insecticide. A general discussion of this material as an insecticide for the gardens will be found on page 28.

For more detailed information regarding the identity and control of insects and diseases affecting vegetable gardens the grower should consult experienced local gardeners or write to the county agricultural agent, State agricultural college, State department of agriculture, extension service, or the United States Department of Agriculture. When writing for information on pest control it is important to send specimens of the disease or insect which will identify the trouble, so that the proper recommendations for control can be made.

This publication is a revision of and supersedes Miscellaneous Publication No. 525, A Victory Gardener's Handbook on Insects and Diseases, which was issued in February 1944 and slightly revised in July 1944.

Washington, D. C.

Issued May 1946

UNITED STATES DEPARTMENT OF AGRICULTURE

Miscellaneous Publication No. 605

Washington, D. C., May, 1946

A VEGETABLE GARDENER'S HANDBOOK ON INSECTS AND DISEASES

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NECESSITY OF PEST CONTROL BY THE VEGETABLE GARDENER

The control of the insects and diseases that affect vegetable crops is essential to the successful production of the farm, suburban, city, and community gardens that are being planted each year. The production of vegetables in these gardens during the postwar period will aid greatly in relieving the food shortage.

Regardless of the care and skill shown in the selection of a garden site, in the cultivation and fertilization of the soil, and in the selection and planting of seeds or transplants, all such efforts, involving the use of seeds, fertilizers, and tools, may be partially or completely nullified by depredations of insects and diseases unless steps are taken to control them.

PRECAUTIONS TO BE TAKEN WITH INSECTICIDES AND FUNGICIDES

In handling, mixing, and applying poisonous insecticides and fungicides, take special care not to inhale excessive quantities at any time. Well-designed respirators that afford protection to the entire face are available; therefore, use these when such danger exists. After working with insecticides, wash the hands or any exposed parts of the body thoroughly.

Containers in which these materials are kept or stored should be plainly labeled and placed under lock and key, or at least out of the reach of irresponsible persons or children. Any unused portions of these poisonous preparations as well as the recep-

tacles in which they have been mixed should be treated likewise.

Experience and careful observation have shown that if the poisoned baits mentioned herein are prepared and applied according to directions, their use will not be hazardous to domestic animals, poultry, or wildlife.

WARNING REGARDING POISON RESIDUES

Unless the poison residues can and will be removed by washing or stripping, do not apply to the crop any spray, dust, solution, or bait that contains such materials as paris green, calcium arsenate, cryolite, barium fluosilicate, sodium fluosilicate, sodium fluoride, tartar emetic, corrosive sublimate, calomel, or DDT, when foliage or fruit that is intended to be eaten is on the plants.

Apply all insecticides or other chemicals as sparingly as is consistent with the control of the insect or the disease that is being combated. When dusting or spraying, make every effort to apply a light, even coating. Avoid unnecessarily heavy applications.

WHERE TO GET INSECTICIDES AND FUNGICIDES

Information regarding the purchase of the insecticide and fungicide materials may be obtained through experienced local gardeners, local dealers in agricultural supplies, and seedsmen; or through the county agricultural agent, State agricultural college, State department of agriculture, extension service, or the United States Department of Agriculture.

—ASPARAGUS—

Insect or Disease



5 times natural size.

Asparagus beetle: Metallic blue to black, $\frac{1}{4}$ inch long. Orange to yellow markings. Larvae olive-colored and humped, $\frac{1}{2}$ inch long.

Adults and larvae feed on full-grown plants, and early shoots may be gnawed at and disfigured.

May be a pest wherever asparagus is grown except in California.

Rust (fungus): Elongated, orange-red, powdery pustules on stems and foliage; turning dark in fall. Tops die early and next year's crop is reduced. Most serious in moist seasons.

Common wherever asparagus is grown.

Remedy

When edible shoots are infested, use rotenone (dust mixture 18, p. 25, or spray mixture 5, p. 25).

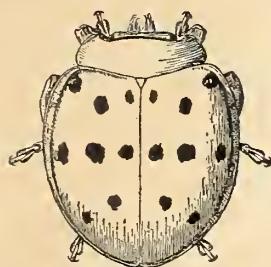
After cutting for the season has been completed, use calcium arsenate (dust mixture 14, p. 25, or spray mixture 1, p. 25).

Shoots intended for eating should not be poisoned with calcium arsenate.

See warning regarding residues on page 1.

Plant rust-resistant varieties, Mary Washington or Martha Washington. Use seed of a dependable strain whose resistance has been maintained. Cut tops close to ground in fall and burn them.

—BEANS—



5 times natural size.

Mexican bean beetle: Adult copper colored with 16 black spots on back. Oval shape, $\frac{1}{4}$ inch long. Larvae orange to yellow and fuzzy.

Lower surface of leaf eaten between veins, appearing skeletonized. Pods also damaged.

A pest in most States east of the Mississippi River and in Colorado, New Mexico, Arizona, western Texas, Nebraska, South Dakota, and Wyoming.

Spray under sides of leaves with rotenone (spray mixture 5, p. 25), or dust with rotenone (dust mixture 18, p. 25) every 10 days. Cryolite (spray mixture 2, p. 25, or dust mixture 15, p. 25) may be used until the pods begin to form. Hand picking of beetles and crushing of egg masses is effective if done often. Do not use lead arsenate or paris green on beans, as either of these will injure the plant.

See warning regarding residues on page 1.



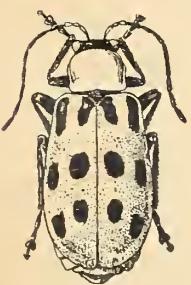
5 times natural size.

Bean leaf beetle: Adult reddish to yellowish, with 4 black spots on back.

Regular-shaped holes eaten in leaves. Occurs in all eastern States, but damage is usually restricted to small areas.

Same as for Mexican bean beetle.

See warning regarding residues on page 1.



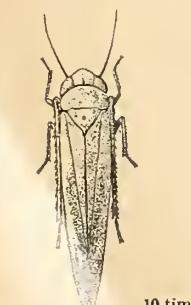
5 times natural size.

Spotted cucumber beetle: Adults about $\frac{1}{4}$ inch long, yellow-green with 12 spots on back.

Holes eaten in leaves. Pods also damaged. Beans grown east of the Rocky Mountains subject to some damage each year.

Another closely related species damages beans in California, Washington, and Oregon.

Same as above.



10 times natural size.

Leafhoppers (cause hopperburn): Adults small, green, active, wedge-shaped, in some localities called "white flies."

Tips of leaves become dry and brown. Occurs east of the Rocky Mountains. Damages beans in the Southern and Eastern States.

Dust under sides of leaves with sulfur-pyrethrum (dust mixture 21, p. 26).

BEANS—Continued

Insect or Disease

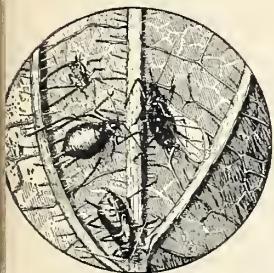


5 times natural size.

Seed-corn maggot: Legless white maggot similar to cabbage maggot. Bores into sprouting seed and prevents development of the plant. Damage may occur in any section of the United States; particularly destructive in the Eastern States in the early part of the season.

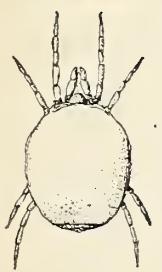
Remedy

As soon as maggot injury is discovered, replant. Avoid organic fertilizer in seeded row. Partially decayed vegetable matter attracts the flies, and lands containing such material are likely to become infested with maggots which will attack germinating seed. Plant seed shallow in such lands, and prepare seedbed so as to promote rapid germination; plant seed when the soil is warm. Cool, wet periods retard seed germination and promote maggot injury.



Aphids (plant lice): Small black insects clustered on stems and under leaves. Leaves curl and thicken, and plants become yellowed and have unthrifty appearance. Occurs over the United States. Damage is of local character.

Dust with nicotine dust (dust mixture 17, p. 25) or spray with nicotine sulfate (spray mixture 4, p. 25). Dust or spray with nicotine only when temperature is 65° F. or above. Soap spray (spray mixture 12, p. 26) is fairly effective.



40 times natural size.

Red spiders: Very small, red or greenish-red mites on under side of leaves. Injured leaves turn yellow, and plants are stunted. Occurs all over the United States but is most likely to cause damage under dry, hot conditions.

Dust with sulfur.

Seed decay (fungus): Most common in cool, moist weather.

Treat seed with Sperton or Arasan (p. 27). Treatment is most important for lima beans.

Anthracnose (fungus): Pods show round, sunken spots with dark, reddish-brown borders and pink centers. Elongated, dark-red cankers on stems and leaf veins. Ripe seeds show rusty-brown spots. Fungus carried in seed. Most common in cool, moist summers. May occur in the Central, Northeastern, and Southeastern States.

Do not save seed from spotted pods or plant seed showing any discoloration. Do not work in garden when plants are wet. Use western-grown seed. Spraying or dusting is of no value.

Bacterial blights: Leaves show large, dry, brown spots with yellow borders. Reddish cankers on stem, which may cause girdling. Water-soaked spots with reddish margins on pods. May occur wherever beans are grown but seldom found in most Intermountain and Pacific Coast States.

Same as for anthracnose. Seed from far western States is largely free from blight. Stringless Green Refugee, Idaho Refugee, U. S. No. 5 Refugee, and Blue Lake (pole) are somewhat more tolerant than most varieties.

Rust (fungus): Appears chiefly on leaves as red pustules which become black late in the season and cause defoliation. May occur in most regions where beans are grown, except in a few semiarid sections.

Spraying with wettable sulfurs or bordeaux mixture, or dusting of plants with sulfur may be effective. The following snap bean varieties are fairly tolerant: Stringless Black Valentine, Landreth Stringless Green Pod, Tendergreen, Penel Pod Black Wax, Round Pod Kidney Wax, Rust Resistant Kentucky Wonder (pole).

Mosaic (virus): Mottling of leaves in light- and dark-green areas, accompanied by more or less curling and stunting of foliage and reduction in yield. Carried in seed and where once introduced spread by plant lice. Common throughout United States.

The varieties Idaho Refugee, U. S. No. 5 Refugee, and Sensation Refugee No. 1066 and No. 1071 are resistant. Varieties such as Bountiful, Stringless Black Valentine, Tendergreen, Full Measure, Brittle Wax, Burpee's Stringless Green Pod, and Kentucky Wonder (pole) are mosaic-tolerant.

BEETS

Insect or Disease



15 times natural size.



About natural size.

Flea beetles: Small, black, or striped; jump like fleas. Small holes eaten in leaves of seedling plants. Several species may cause damage wherever beets are grown.

Remedy

Dust with rotenone (dust mixture 18, p. 25), or spray with rotenone (spray mixture 5, p. 25).

Beet webworm: Larvae greenish-white to dark-brown caterpillars. Leaves and buds of young, tender plants eaten. Feeding surfaces often covered with webs. Occurs quite generally and may be especially troublesome in the Western States.

Dust with pyrethrum (dust mixture 19, p. 25).

Damping-off (fungus): Decay of seed in soil and death of young seedlings.

Treat seed with red copper oxide, Arasan, or Semesan (p. 27).

Leaf spot (fungus): Leaves show numerous small, round, dead spots with white centers and purple borders. Common in most of United States.

Ordinarily leaf spot is not severe enough on garden beets to require treatment. Spraying with bordeaux mixture (spray mixture 8, p. 26) will control the disease to some extent.

BROCCOLI AND BRUSSELS SPROUTS

Aphids (plant lice): Small, green, sucking insects clustered on under side of leaves or on stems. See illustration under Beans. Leaves curled; plants yellowed.

Same as for bean aphid.

Caterpillars (cabbage worms): See Cabbage.

See Cabbage.

See warning regarding residues on page 1.

Flea beetles: See Cabbage.

See Cabbage.

Aphids, caterpillars, and flea beetles damage broccoli and brussels sprouts wherever these crops are grown.

See Cabbage.

Damping-off, clubroot, black rot, blackleg: See Cabbage.

See Cabbage for methods of control.

CABBAGE



Cabbage caterpillars: Larvae, green or striped caterpillars on leaves or head. Three different caterpillars are illustrated at the left. The one at the top is the imported cabbage worm, which is recognized by its velvety skin. In the middle is the cabbage looper shown in a characteristic pose. At the bottom is shown the caterpillar of the diamondback moth on a piece of a leaf which it has been eating. A small area of the lower leaf surface has been eaten, and the caterpillar is often found in or near this spot. If disturbed it will wriggle vigorously and drop from the leaf, hanging to it, however, by a slender thread of silk. All three caterpillars are drawn slightly less than natural size.

Holes eaten in leaves.

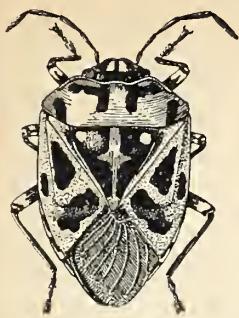
Damage cabbage wherever grown.

Before the heads or parts that are to be eaten begin to form: Dust with calcium arsenate undiluted, or cryolite (dust mixture 15, p. 25); or spray with calcium arsenate (spray mixture 1, p. 25), or cryolite (spray mixture 2, p. 25).

After the heads or parts that are to be eaten begin to form: Apply a rotenone dust mixture (dust mixture 18, p. 25) or a rotenone spray (spray mixture 5, p. 25) or a pyrethrum dust (dust mixture 19, p. 25) or a pyrethrum spray (spray mixture 6, p. 25). If diamond-back moth caterpillars are abundant, use rotenone dusts or sprays rather than pyrethrum.

See warning regarding residues on page 1.

Insect or Disease



3 times natural size.

Harlequin bug: Shield shaped; black, brilliantly colored with red or yellow, about $\frac{3}{8}$ inch long.
Plants wilt, turn brown as if scalded.
Damage usually local in nature; but pest occurs in the southern part of the country in damaging numbers from California to Virginia.

Remedy

Hand-pick bugs and egg masses.

Flea beetles: Small, black or striped beetles; jump like fleas. See flea beetles on beets for a picture of one of these insects.
Small holes eaten in leaves. Especially damaging to young plants.
The cabbage aphid and flea beetles occur wherever cabbages are grown, and damage is of a local nature.

Same as for bean aphid.

Cabbage maggot: Legless, white maggots $\frac{1}{4}$ to $\frac{1}{2}$ inch long.
Larvae, or worms, tunnel roots causing rot; plants wilt. Particularly destructive in seedbeds and to young plants after setting in the field.
Occurs over a wide area in the northern part of the country from Minnesota eastward. Damage probably more severe in the Northeastern States than elsewhere.



5 times natural size.

Dust with cryolite (dust mixture 15, p. 25), or spray with cryolite (spray mixture 2, p. 25), until heads or parts that are to be eaten begin to form. After this stage use rotenone dust (dust mixture 18, p. 25) or rotenone spray (spray mixture 5, p. 25). See warning regarding residues on page 1.

Corrosive sublimate solution (bichloride of mercury) or calomel (solution 13, p. 26). Pour $\frac{1}{2}$ cupful of solution on soil at base of each plant soon after setting and 10-12 days later. In seedbed, or for plants in rows, apply at base of plants at rate of 1 gallon per 35 feet of row. A tar-felt or light roofing paper disk placed around the base of the stem of each plant will aid in maggot control. Such a disk should be about 3 inches in diameter, fitted snugly around the stem. This disk should be put in place immediately after the setting of the plants in the garden (fig. 10, p. 30). See caution regarding use of poisons on page 1.

Treat seed with Semesan, Arasan, or Spergon (p. 27).
Do not use red copper oxide.

Damping-off (fungus): Decay of seed in soil and collapse and death of young seedlings.
Clubroot (slime mold): The slime mold enters roots and produces large, irregular swellings and malformations. Plants are sickly and stunted. Attacks plants both in seedbed and field and affects other cultivated plants of cabbage family.
Occurs throughout the United States.

Do not attempt to grow cabbage or related plants in soil where disease has been severe. Grow seedlings in clear soil. Do not use plants showing slight swellings on roots. Rotate crop in garden. Where soil is not severely infested the use of a 1:1,500 solution of corrosive sublimate for watering the plants at time of transplanting may be helpful (p. 27).

Root knot (eelworm or nematode): Smaller swellings on roots than with clubroot; more evenly distributed over feeding roots. If swellings are broken open they show pearly-white specks which are egg-bearing nematodes. Affects other plants in garden, while clubroot is found only on cabbage, brussels sprouts, cauliflower, and other plants of the cabbage group.
Most common in Southern States.

Do not plant cabbage where root knot has been found on roots of plants. Endeavor to use new land if present garden soil is infested with root knot organisms. Grow seedlings in nematode-free soil. Burn all infested roots.

Insect or Disease

Remedy

Yellows, or **wilt** (fungus): Plants are stunted, yellowish-green; lower leaves drop. Plants often have a one-sided appearance and those that live through the season rarely make good heads. Fungus lives in the soil and enters plant through roots. Affects cabbage, kohlrabi, and kale severely; cauliflower, broccoli, and Brussels sprouts are resistant.

May occur wherever cabbage is grown.

Start seed in clean soil and never set diseased plants. Spraying is of no value. Where yellows occurs, use resistant varieties, such as Jersey Queen, Resistant Detroit, Marion Market, Globe, Wisconsin Ball-head, or Wisconsin All-Season.

Black rot (bacterial): Leaves yellowed at edges, with blackened veins, and may drop from plants. Stems show a blackened ring when cut across. Plants often die or may not form heads. Also affects other members of cabbage group, particularly cauliflower. Bacteria are carried in seed and live in the soil.

Common in the Central, Southern, and Eastern States.

Plant seed in soil that has not grown cabbage. Seed from Pacific Coast regions is free from black rot. Seed grown elsewhere may be infected but can be disinfected by hot-water treatment. (See Farmers' Bulletin 1862, Vegetable Seed Treatments.)

Blackleg (fungus): Seedlings show ashen-gray spots on leaves and stems. These spots are covered with tiny black dots characteristic of the disease. Stems may be girdled and plants may wilt and die when small or break over after heads are formed. Fungus is carried in seed and lives on crop refuse in soil. Affects all plants of the cabbage family.

Common in the Central, Eastern, and Southern States.

Use same methods as recommended for black rot.

CANTALOUP OR MUSKMELON

Aphids (plant lice): Small, green to black, soft-bodied insects; clustered on under side of leaves. See illustration under Beans.

Leaves curled, distorted, yellowed; plants stunted.

Plant lice occur wherever melons are grown, but are more likely to be destructive in the southern part of the country than elsewhere.

Same as for aphids on beans. Destroy or cover heavily infested plants with soil to prevent spread.

Do not use sulfur on cantaloup or muskmelon plants.



Striped cucumber beetle: Yellow and black beetle $\frac{1}{5}$ inch long; 3 black stripes down back. The worm, or larva, is $\frac{1}{8}$ inch long, slender, and white, brownish at ends.

Young plants attacked, followed by wilting; holes eaten in leaves. Larva bores into or feeds on roots and on stems at and below the soil line.

Occurs generally over the country east of the Rocky Mountains. Another species damages melons in the Western States.

Dust with cryolite (dust mixture 15, p. 25) or rotenone (dust mixture 18, p. 25), or dust with a mixture of 1 pound of calcium arsenate and 15 pounds of gypsum (land plaster) once or twice a week.

See warning regarding residues on page 1.

6 times natural size.

Spotted cucumber beetle: Yellow-green beetle with 12 black spots on the back. See under Beans for a picture of the spotted cucumber beetle.

Young plants attacked; holes eaten in the leaves.

Occurs wherever melons are grown east of the Rocky Mountains. Another species injures melons on the West coast. Damage of a local nature.

Same as above.

CANTALOUP OR MUSKMELON—Continued

Insect or Disease



Nearly twice natural size.

Melon worm and pickleworm: Whitish to greenish worms up to $\frac{1}{4}$ inch long, with brownish heads.

Foliage and buds attacked; worms feed in the fruit. Presence shown by small holes usually on under side of melon.

The two worms are particularly destructive in the Southern States and the pickleworm may damage late melons as far north as New York and into the Central States.

Damping-off (fungus): Decay of seed in soil and collapse and death of young seedlings.

Anthracnose (fungus): Reddish-brown, roughly circular spots on leaves; elongated, tan-colored cankers on stems. Green fruits show round, sunken spots with pinkish-tan centers, turning dark later. Fungus carried on seed and lives in soil. Worst in warm, moist weather. Also attacks cucumber and watermelons.

Common in the Central, Eastern, and Southern States.

Downy mildew (fungus): Yellowish, somewhat irregular spots on leaves; followed by drying, curling, and death of older foliage. Fruit not affected. Not carried on seed. Attacks cucumbers.

Often destructive in Southern and Atlantic Coast States.

Bacterial wilt: Vines gradually wilt and die. Young plants are soon killed, but older vines at first may have only one shoot affected. No yellowing of leaves. Caused by bacteria entering and plugging water vessels of stem and leaves. Bacteria are not carried on seed or in soil but are spread by cucumber beetles, in which they also live over the winter. Attacks cucumber and squash.

Common in North-Central, and Northeastern States.

Leaf spot (fungus): Numerous small, round, dead spots on leaves; no spotting of fruit. Leaves may be killed. Common on muskmelon and occurs on cucumber.

Common in Central, Southern, and Atlantic States.

Mosaic (virus): Leaves show yellow and green mottling and plants are somewhat stunted. Fruit not spotted but of poor quality. Different forms of virus exist. Most common type of virus not carried in seed but some forms occasionally are. Not carried in soil; virus lives over in perennial weeds and is spread by plant lice.

May occur wherever vine crops are grown.

Remedy

Before fruits form: Dust growing tips and blossoms with cryolite (dust mixture 15, p. 25) once a week, beginning when worms are first found.

After fruits form: Dust with rotenone (dust mixture 18, p. 25).

See warning regarding residues on page 1.

Treat seed with Semesan, red copper oxide, Arasan, or Spergon (p. 27).

Treat seed with 1:1,000 corrosive sublimate (p. 27). Do not grow cucumbers or melons on same land oftener than every 3 years. Spraying with bordeaux mixture (spray mixture 8, p. 26), or dusting with copper dust (p. 28), may be necessary if disease appears early in season.

Spraying or dusting as for anthracnose may keep plants alive for 2 to 3 weeks longer than unsprayed plants, but foliage must be well coated on under surface.

Pull and burn all wilted plants found early in season. Follow recommendations for control of cucumber beetles given on page 6.

See recommendations for control of anthracnose.

Keep down all perennial weeds near garden, particularly ground-cherry, pokeweed, catnip, and milkweed. Do not grow wild cucumber as an ornamental vine. The virus lives in the roots or seed of these plants and is carried to the cultivated cantaloup by plant lice. Peppers, celery, and tomatoes are also susceptible to this mosaic virus.



Slightly less than natural size.

Carrot caterpillar: Large worm up to 2 inches long, green, banded with black and yellow markings.

Leaves eaten; tops destroyed.

Widely distributed but only occasionally becomes numerous enough to cause damage.

Hand-pick.

CARROTS

CARROTS—Continued



4 times natural size.

Insect or Disease

Carrot rust fly: $\frac{1}{8}$ inch long; yellowish white, legless maggot.

Destruction of fibrous roots; tunneling in fleshy roots.

Damage caused by the rust fly is restricted to the coastal areas of Washington and Oregon, and in Michigan, northern Ohio, Pennsylvania, New Jersey, New York, Massachusetts, Connecticut, Vermont, New Hampshire, and Maine.

Leaf blight (fungus): Black or brown spotting of leaves and leaf stalks followed by drying and death of older foliage.

Occurs in most sections where carrots are grown.

Remedy

Apply naphthalene or a mixture of calomel with water. The success of the remedy depends upon timeliness of treatment. Consult your local entomologist.

Rotate crop in garden. Chantenay variety somewhat resistant. If disease is commonly destructive, spray with bordeaux mixture (spray mixture 8, p. 26), but spraying is usually unnecessary.

CAULIFLOWER

Aphids (plant lice): See cabbage aphid.

Same as for cabbage aphid.

Caterpillars: Larvae, green or striped worms on leaves or head. See under Cabbage for pictures of some of these caterpillars.

Holes eaten in leaves.

Aphids and caterpillars damage cauliflower wherever it is grown in the United States.

Same as for caterpillars on cabbage.

Damping-off, clubroot, black rot, black leg: (See Cabbage).

Same as for cabbage.

CELERY



Twice natural size.

Celery leaf tier: Small, greenish caterpillar that webs the leaves.

Webbing of leaves and hole in stalk.

Damage to celery sometimes serious in Florida and California and in northern celery-growing areas.

Dust with pyrethrum (dust mixture 19, p. 25). Repeat in $\frac{1}{2}$ hour.

Early blight (fungus): Small circular, yellowish-brown spots on older leaves that enlarge and turn dark, later changing to ashen gray. Leaf stalks are affected. Fungus lives over in the soil and is spread by rain.

Common in most celery-growing regions.

If disease appears, spray young plants with bordeaux mixture (spray mixture 8, p. 26) or dust with copper-lime dust, repeating at 10-day intervals (p. 28). Destroy plant refuse in fall and rotate crop.

Late blight (fungus): Small, yellow spots on older leaves and leaf stalks, later turning almost black. Spots covered with minute black dots, which distinguish it from early blight. Fungus carried on seed. Occurs in most celery-growing regions.

Same as for early blight, but where disease is common spraying should begin in seedbed. Rotate crop and destroy plant refuse in fall.

Pink rot (fungus): Watery spots at base of older plants, followed by white, cottony fungus growth which develops a pink color. Stalks are rotted and have bitter taste. Fungus, which also attacks cabbage and lettuce, lives over for years in soil.

Most common in Southern States but occurs in North-Central and Northeastern States.

Avoid planting celery, lettuce, or cabbage in immediate succession on same soil. Remove and burn infected plants.

Yellows (fungus): Stunting, yellowing, and sometimes death of plant. Fungus lives for years in soil and attacks plant through roots.

Most common in Central and Eastern States.

Avoid infected soil if possible. Use yellow-resistant varieties such as Michigan Golden, Florida Golden, or Forbes Golden Plume, if self-blanching varieties are desired. Green celeries are generally resistant.

CHARD

Insect or Disease

Flea beetles: See Beet.

Remedy

Dust with rotenone (dust mixture 18, p. 25), or spray with rotenone (spray mixture 5, p. 25).

Leaf spot (fungus): See Beet.

Same as for beet.

COLLARDS

Aphids: See Cabbage aphid.

Same as for bean aphid.

Caterpillars: See Cabbage.

Same as for caterpillars on cabbage.

Flea beetles: See Cabbage.

Same as for flea beetles on cabbage.

Harlequin bug: See Cabbage.

Same as for harlequin bug on cabbage.

Clubroot, black rot, yellows, blackleg: See Cabbage.

Same as for cabbage.

CORN—See Sweet Corn

CUCUMBER

See Cantaloup for insects.

Do not use sulfur on cucumber plants.

Damping-off, anthracnose, downy mildew, bacterial wilt, leaf spot: See Cantaloup.

Same as for cantaloup.

Mosaic (virus): Leaves mottled with yellow spots, curled, and dwarfed. Fruits mottled with yellow, misshapen and warty. Infected plants of little value. Not carried in seed or soil. Lives over in perennial weed hosts. Spread by plant lice and cucumber beetle.

Same as for cantaloup. The Shamrock variety is resistant to mosaic.

Common throughout the United States.

EGGPLANT

Colorado potato beetle: See Potato.

Same as for potato beetle on potato except that if the treatment is made after the fruits form, the fruits should be carefully washed or wiped before preparation for the table.

Do not use paris green on eggplants or tomatoes.



3 times natural size.

Flea beetles: Black or brown jumping beetles, $\frac{1}{16}$ inch long. See flea beetles on beets for a picture of one of these insects. Small holes eaten in the leaves. Young plants suffer the most from attacks of these pests and become stunted. Damage occurs in most of the areas where eggplant is grown.

Dust with cryolite (dust mixture 15, p. 25), or spray with cryolite (spray mixture 2, p. 25), or spray with calcium arsenate-bordeaux mixture (spray mixture 9, p. 26), before fruit begins to form.

After fruits form: Use rotenone dust (dust mixture 18, p. 25), or rotenone spray (spray mixture 5, p. 25).

See warning regarding residues on page 1.



About $\frac{1}{2}$ natural size.

Hornworms: Large, green worms with diagonal lines on sides, with prominent horn at rear end.

Eat foliage and fruit. Widely distributed but only occasionally damages eggplant.

Hand pick.

EGGPLANT—Continued

Insect or Disease	Remedy
Aphids: Green, soft-bodied insects; clustered on leaves. Leaves curled and distorted; plants yellowed. Widely distributed and in some seasons may cause serious damage.	Same as for bean aphid.
Damping-off (fungus): Seeds decay and young seedlings fall over and die.	Treat seed with red copper oxide, Arasan, or Semesan (p. 27).
Fruit rot (fungus): Attacks plants at any stage. Stem often affected at ground line, becoming brown and shrunken. Brown or gray spots on leaves; leaves may die. Large, ringed, circular, tan or brown spots on fruit; covered with small pustules. Carried in seed and soil. Common throughout United States.	Save seed from sound fruit or treat seed with 1:1,000 corrosive sublimate for 10 minutes (p. 27). Rotate crop in garden.
Wilt diseases (fungi): Gradual wilting, stunting, and occasionally death of plant. Occur wherever eggplant is grown.	Avoid land that has recently grown tomatoes or potatoes. Rotate crop.

KALE AND KOHLRABI

Aphids: See Cabbage aphid.	Same as for bean aphid.
Caterpillars: See Cabbage.	Same as for caterpillars on cabbage.
Flea beetles: See Cabbage.	Same as for flea beetles on cabbage.
Harlequin bug: See Cabbage.	Same as for harlequin bug on cabbage.
Clubroot, black rot, yellows, and blackleg: See Cabbage.	Same as for cabbage.

LETTUCE



Slightly less than natural size.

Aphids: Green, soft-bodied insects; clustered on leaves. Generally similar to the aphids found on beans. See illustration there. Leaves curled and distorted. Widely distributed and in some seasons may cause damage in garden areas.	Same as for aphids on beans.
Loopers: Green measuring worms. Ragged holes eaten in leaves. Widely distributed but only occasionally damage lettuce in most localities. May be particularly destructive in Florida, California, and Arizona.	Dust with rotenone (dust mixture 18, p. 25) or pyrethrum (dust mixture 19, p. 25).
Drop (fungus): Wilting of outer leaves followed by rapid wilting and decay of entire plant; watery soft rot of stem and older leaves; worst in moist weather. Common in the Central, Eastern, and Southern States.	Avoid too close planting and poorly drained soil. Ridge soil about plants slightly to prevent water standing about stems.
Yellows (virus): Yellowing, blanching, curling, and twisting of inner leaves. Abnormal production of small shoots. Affects various plants of lettuce family and many other wild and cultivated plants. Spread by leafhoppers. Occurs throughout United States.	No particularly effective control is known.
Tipburn (physiologic): Under adverse temperature conditions the margins of the most rapidly growing leaves turn brown and dry. Occurs wherever lettuce is grown.	Most serious on head lettuce. Varieties Imperial 44 (for very early and fall planting), New York 12, and Imperial 847 are resistant.

MUSTARD—See Turnip

ONIONS

Insect or Disease



25 times natural size.

Thrips: Very tiny, active, yellow insects, $\frac{1}{25}$ inch long. Whitish blotches on leaves; tips of leaves wither and turn brown. Widely distributed; causes some damage nearly every season.

Remedy

Spray with nicotine sulfate (spray mixture 4, p. 25) or tartar emetic (spray mixture 11, p. 26). Soap spray (spray mixture 12, p. 26) is fairly effective. Increased efficiency can be obtained with the nicotine sulfate mixture by substituting 8 tablespoonsfuls ($\frac{1}{2}$ cup) of sirup (corn, cane, or maple) for soap. See warning regarding residues on page 1.

Onion maggot: Small, white worm, $\frac{1}{2}$ inch long. Similar in size and appearance to cabbage maggot.

Burrows into onion bulbs.

This insect is not known as a pest in California or in the southern half of the United States; it is a major pest of onions in some of the North-Central and Northeastern States.

Smut (fungus): Causes blisters full of black, powdery masses of fungus on leaves of young plants, often killing them. Fungus lives over in soil where disease has occurred.

Most common onion disease in the Northern States but does not cause loss in the Southern or Southwestern States.

Treat with corrosive sublimate or calomel as outlined under Cabbage maggot, page 5.

Avoid soil where smut has been found on previous crops. If this cannot be done, sprinkle formaldehyde solution (1 teaspoonful to 1 quart of water) in drill where seeds have been dropped, before covering them. Use 3 quarts of solution to 100 feet of row.

OKRA

Aphids: Green to black, soft-bodied insects; clustered on under side of leaves. See illustration under Beans.

Leaves curled and distorted; plants stunted. Damage may occur wherever okra is grown.

Same as for aphids on beans.

Corn earworm: Green or brownish worm, up to $1\frac{3}{4}$ inches long with light stripes.

Holes eaten in pods. Damage often minor but may occur wherever okra is grown.

Hand-pick and destroy damaged pods and worms.

Root knot (eelworm or nematode): Gall-like swellings on roots and some stunting of plants.

Occurs commonly in the Southern and Southwestern States.

Avoid planting on soil badly infested with root knot; rotate garden plot where possible. Burn diseased roots.

Wilt (fungus): Yellowing and wilting of leaves and stunting of plants.

Occurs in the Southern States, but is only occasionally serious.

Avoid land where disease has occurred and do not grow in same spot more than once in 3 years.

PARSNIP

Caterpillar: See Carrot.

Same as for carrot caterpillar.

Carrot rust fly: See Carrot.

Same as for cabbage maggot.

PEAS, GARDEN

Pea aphid: Pale-green plant lice clustered on leaves, buds, and pods. Similar in general appearance to the aphids found on beans. See illustration under Beans.

Leaves turn yellow; plants stunted; pods misshapen.

Damage may occur wherever garden peas are grown.

Dust with nicotine (dust mixture 17, p. 25) or rotenone (dust mixture 18, p. 25), or spray with nicotine (spray mixture 4, p. 25) or rotenone (spray mixture 5, p. 25). Soap spray (spray mixture 12, p. 26) fairly effective.

Insect or Disease



Pea weevil: Parent weevil is brownish with white, black, and grayish markings, $\frac{1}{8}$ inch long. Weevil grubs are white with small brown head and mouth, $\frac{1}{8}$ inch long.

Infested peas have cavities made by weevil grubs.

Generally distributed, but damage is confined principally to Utah, Idaho, Washington, Oregon, New York, and Wisconsin.

5 times natural size.

Seed-corn maggot: Legless white maggot similar in size and appearance to cabbage maggot.

Bores into sprouting seed and prevents development of the plant.

Damage may occur in any section of the United States; particularly destructive in the Eastern States in the early part of the season.

Remedy

Dust with rotenone (dust mixture 18, p. 25).

Apply to pea plants in infested fields after blossoming and before the first tiny pods appear.

As soon as maggot injury is discovered, replant. Avoid organic fertilizer in seeded row. Partially decayed vegetable matter attracts the flies, and lands containing such material are likely to become infested with maggots which will attack germinating seed. Plant seed shallow in such lands, and prepare seedbed so as to promote rapid germination; plant seed when the soil is warm. Cool, wet periods retard seed germination and promote maggot injury.

Treat seed with Spergon or Arasan (p. 27).

Seed decay (fungus): Most common in cool, moist weather.

Ascochyta pod spot (fungus): Irregular, light-colored spots with dark margins on pods; concentric circular spots on leaves with tiny, dark dots in centers; stems also spotted near ground. Fungus carried on seed and lives on old vines.

Most likely to occur in the Central, Southern, and Northeastern States.

Root rots (fungus): Plants do not grow vigorously; many turn yellow and may die at flowering time. Stems below ground and roots are decayed and yellowish brown, red, or black. Caused by soil-borne fungi.

Occur wherever peas are grown.

Spraying of no value. Burn diseased vines after crop is picked. Plant clean seed. Varieties such as Short Admiral, Champion of England, Horsford, Perfection, and Advance are somewhat tolerant. Seed grown in semiarid West is relatively disease-free.

Do not grow peas continuously on same soil. Use well-drained soils, since excessive soil moisture favors root rots.

If possible, use seed grown in semiarid regions of the West. Spraying is of no value.

Bacterial blight: Large, water-soaked spots on pods and irregular, dark spots on leaves. Cream-colored, shining ooze in centers of spots. Bacteria are carried on seed.

Rather common in most localities where peas are grown but rare in semiarid regions of the West.

Fusarium wilt (fungus): Leaves are yellow and plants may wilt and die. Interior of stems colored lemon-yellow. Caused by soil-borne fungus which enters through the roots.

No cure for diseased plants. If disease is troublesome, use resistant strains of garden varieties such as Dwarf Alderman, Teton, Asgrow 40, and Telephone.

PEAS, BLACK-EYE



5 times natural size.

Cowpea curculio: Black humpbacked beetle, $\frac{1}{4}$ inch long with long snout, which in the specimen illustrated is doubled back under the body.

Small holes eaten in pods and developing black-eye peas.

Damage to black-eye peas and cowpeas occurs in States east of the Mississippi River and south of Tennessee and Virginia.

Seed-corn maggot: See Seed-corn maggot under Peas, Garden.

Spray with eryolite (spray mixture 2, p. 25), or dust with eryolite (dust mixture 15, p. 25).

Do not apply eryolite within 2 weeks before picking.

Same as on garden peas.

PEPPER

Insect or Disease



About $\frac{1}{2}$ natural size.

Hornworms: Large, green worms with diagonal lines on sides, with prominent horn on rear end. Eats foliage and fruit. Damage to peppers occurs only locally. Hornworms occur wherever peppers are grown.

Remedy

Hand picking.

Damping-off (fungus): Decay of seed in soil and wilting and death of small seedlings.

Treat dry seed with Arasan or Seimesan (p. 27).

Cercospora leaf spot (fungus): Fungus leaf spot causes circular, water-soaked spots which enlarge and become white in center; similar spots on stems. Caused by fungus which is carried on seed. Common in all but semiarid regions.

This disease is only occasionally destructive. If seed is saved from clean fruits and planted on new seedbed soil, it usually will reduce damage. Commercial seed may be treated for 2 minutes with a 1:2,000 solution of corrosive sublimate (p. 27), but pepper seed is sensitive to injury by this chemical.

Bacterial leaf spot: Causes small, round, water-soaked spots on leaves, which may yellow and drop. Fruits show rough, scabby spots. Carried on seed. Occurs in all but semiarid regions.

Same as above.

Anthracnose (fungus): Most common on ripe fruits, producing large, dark-brown or black spots whose centers show tiny, black specks. Often follows sunscald of older green fruits.

Use clean seed and avoid continuous planting of peppers on the same soil.

Common in Central, Southern, and Atlantic States.

Blossom-end rot (physiologic): Light-colored, sunken, water-soaked spots near blossom end of fruits; these spots enlarge until one-third of the fruit may be affected and become dark and shriveled; spots later may be overgrown by fungi. Occurs throughout the United States.

Avoid excessive use of nitrogenous fertilizer and use ample amounts of superphosphate. If garden is watered, maintain an even soil moisture and avoid overwatering or drying out of soil.

Mosaic (virus): Yellow mottling and dwarfing of leaves, many of which may later drop; severe stunting of plants.

See cucumber mosaic and tomato mosaic for control measures.

Caused by same virus as cucumber mosaic. Peppers are also less commonly affected by the tomato mosaic virus.

Occurs throughout United States.

POTATO



3 times natural size.

Colorado potato beetle: Adults yellow and black striped beetles, $\frac{3}{8}$ inch long. Larvae brick-red and humpbacked. Defoliates plants. May be very destructive to small plantings.

Dust with paris green (dust mixture 16, p. 25), calcium arsenate (dust mixture 14, p. 25), or cryolite (dust mixture 15, p. 25); or spray with paris green (spray mixture 3, p. 25), calcium arsenate (spray mixture 1, p. 25), or cryolite (spray mixture 2, p. 25). Hand picking of the beetles and crushing of the egg masses is effective if done often.

May damage potato and eggplant in all States except California and Nevada. However, its principal damage occurs in the Eastern States. May damage young tomato plants in the Middle Atlantic coastal area.

Flea beetles: Small, black, active jumpers. See flea beetles on beets for a picture of one of these insects.

Dust with cryolite (dust mixture 15, p. 25), or spray with cryolite (spray mixture 2, p. 25), or spray with calcium arsenate-bordeaux mixture (spray mixture 9, p. 26).

Small holes eaten in leaves by adults. Grubs or larvae buried in tuber. Flea beetles attack potatoes in many parts of the United States. The forms which occur in Washington and Oregon are particularly destructive to the tubers.

Rotenone (dust mixture 18, p. 25, or spray mixture 5, p. 25) is also effective.

POTATO—Continued

Insect or Disease



Twice natural size.

Blister beetles: Rather slender, large, gray, black, or striped beetles, $\frac{1}{2}$ to $\frac{3}{4}$ inch long. Leaves eaten. Widely distributed and usually occur on late-season potatoes.

Remedy

Dust with cryolite (dust mixture 15, p. 25), or spray with cryolite (spray mixture 2, p. 25). Hand-pick. Wear gloves while handling because beetles may blister a tender skin.

Leafhoppers: Small, green, active, wedge-shaped insects. See under Beans for an illustration of a leafhopper. Tips and sides of leaves turn brown and curl. May damage potatoes anywhere in its range east of the Rocky Mountains; particularly destructive in the Eastern States.

Spray with bordeaux mixture (spray mixture 8, p. 26) or dust with sulfur-pyrethrum (dust mixture 21, p. 26).



Nearly 3 times natural size.

Potato tuber worm: Pinkish-white worm, up to $\frac{1}{2}$ inch long, with brown head. Tunnels in stems, leaves, and tubers. Shoots wilt and die. Occurs in damaging numbers in restricted localities in certain southern States and in California.

Cultivate well. Keep deeply hilled. Do not leave potato tubers exposed in field after digging.

Common scab (fungus): Causes rough, seabby, raised, or pitted spots on the tubers. One of the most common potato diseases; also affects parsnips, carrots, and beets. Caused by a soil fungus that may be carried on tubers. Common throughout the United States.

Use only clean tubers for seed and avoid planting on land where scab has occurred. Do not use lime, wood ashes, or fresh stable manure on scab-infested soil. Varieties Russet Rural and Netted Gem are somewhat resistant to injury by scab.

Late blight (fungus): Causes dark, irregular, dead areas on leaves. Stems also attacked and plants may be killed early in season. Spreads very rapidly in moist, fairly warm weather. Tubers may show a brown rotting in storage. Fungus carried in tubers. Occurs in North-Central, Northeastern, and Atlantic Seaboard States. Also occurs at times on Pacific Coast.

Use clean tubers showing no decay. In regions where the disease occurs, spray with bordeaux mixture (p. 26), using 3 ounces of calcium arsenate to 3 gallons of spray; or dust with copper-lime dust containing 10 percent of calcium arsenate. The variety Sebago is resistant to late blight. Do not dig blighted plants until tops are dead. If late blight rot occurs on stored potatoes, destroy the discarded tubers.

Early blight (fungus): Diseased plants show numerous irregular, dark-brown spots on the leaves. As these spots enlarge they show concentric rings, giving them a targetlike appearance. Much of the foliage may be injured and yields reduced. The fungus, which also causes early blight of tomato, is carried in the soil and may be present in tubers. Common in Central, Southern, and Eastern States.

Spray or dust as for late blight, beginning when spots first appear. Plant only clean tubers.

Mosaic diseases (virus): There are several mosaic diseases which cause various types of light- and dark-green mottling of the leaves, often accompanied by crinkling of the foliage and stunting of the plant. Viruses causing mosaic are carried in tubers and spread by plant lice in the field.

Use of disease-free seed is the only remedy. Many northern States have seed-inspection service and produce "certified" seed which is comparatively free from virus diseases. Home gardeners should use certified stock.

Occur wherever potatoes are grown.

Same as for mosaic.

Leaf roll (virus): Yellowing and dwarfing of plants and an upward rolling of lower leaves, continuing upward. Leaves leathery to touch.

May occur wherever potatoes are grown.

POTATO—Continued

Insect or Disease

Wilt and dry rot (fungus): Yellowing and drooping of plants in dry weather. Inner portions of stems and tubers show a brown ring. Tubers may rot in storage. Fungus is carried in tuber and can live in soil.

May occur anywhere in United States.

Remedy

Spraying will not control wilt. Do not use seed tubers that show internal discoloration. Endeavor to obtain certified seed. Avoid planting on land where wilt has previously occurred.

RADISH

Flea beetles: Small, black or striped beetles; jump like fleas. See flea beetles on beets for a picture of one of the black flea beetles.

Small holes eaten in leaves.

Widely distributed; particularly damaging to seedlings.

Same as for flea beetles on cabbage.

Cabbage maggot: See Cabbage.

Use calomel as for cabbage maggot.

RHUBARB

Rhubarb curculio (rhubarb weevil): Rather large, yellow-dusted snout beetle.

Punctures the stem.

Occurs from New England to Idaho and southward to Florida and Louisiana.

Hand-pick. Destroy all dock plants growing in vicinity of beds, as the weevil breeds in dock plants.

Foot rot or crown rot (fungus): Brown sunken spots appear at base of leaf stalks; leaves wilt and fall over. Infected stalks later may show soft decay. All leaves of infected plants may finally be attacked. Disease spreads rapidly in row.

Occurs in Central and Eastern States.

Dig and destroy infected plants. In making new plantings do not use roots from beds where disease has occurred. Spraying well into crown of plant with bordeaux mixture (spray 8, p. 26) may aid in control but causes unsightly spotting of stalks if applied before harvest.



3 times natural size.

SPINACH

Flea beetles: Greenish-black beetle, $\frac{1}{8}$ inch long, with yellow collar. See Flea beetles on beets for a picture of a smaller type of flea beetle.

Small holes eaten in the leaves.

Common throughout United States.

Same as for flea beetles on cabbage.

Aphids: Greenish-yellow plant lice; clustered on leaves. Generally similar to the aphids found on beans. See illustration there. Leaves curled, distorted. Plants yellowed. Common throughout United States.

Same as for aphids on beans.

Seed-corn maggot: Legless white maggot similar in size and appearance to cabbage maggot.

Feeds on sprouting seed and prevents the plant from developing.

Particularly destructive to fall and spring crops in the Southern States and may cause losses in many areas of the Eastern States through attacks on germinating seed.

Same as for seed-corn maggot on peas.

Seed decay (fungus): Fungi in soil cause seed to decay and reduce stands of plants.

Common throughout United States.

Treat seed with red copper oxide, Arasan, or Sperton (p. 27).

Blue mold (fungus): Yellow spots on upper surface of leaves, which show a downy, purple, or blue-colored mold on under side. Worst when weather is cool and humidity high.

Occurs in Southeastern and Central States.

No preventive treatment. If disease appears, harvest all mature plants at once.

SPINACH—Continued

Insect or Disease

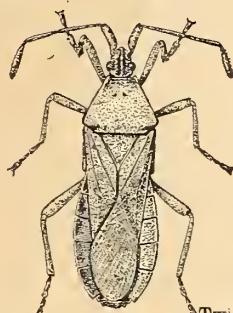
Blight or yellows (virus): Plants become yellow, curl, and commonly die. Caused by cucumber mosaic virus and spread by plant lice.

May occur anywhere in United States.

Remedy

Use resistant varieties: Virginia, Savoy, or Old Dominion. See Cantaloup mosaic for other control measures.

SQUASH AND PUMPKIN



Twice natural size.



A little larger than natural size.

Squash borer: White worms, up to 1 inch long, boring in vines.

Holes in stem near base of runner; runner suddenly wilts.

May damage squash east of the Rocky Mountains.

Hand pick adults and eggs. Trap adults under small pieces of board laid on soil around plants. Collect and kill trapped bugs each morning.

Do not use sulfur on squash or pumpkin plants.

Striped cucumber beetle: See Cantaloup.

Spotted cucumber beetle: See Cantaloup.

Melonworm and pickleworm: See Cantaloup.

Aphids: See Cantaloup.

Bacterial wilt: See Cantaloup.

Mosaic (virus): Mottling of leaves and occasionally of fruits; most serious on summer squash.

Occurs occasionally throughout United States.

Locate point of attack. Slit carefully through one side of stem and puncture worms with razor blade or sharp knife. Mound dirt around stem so as to prevent drying of the injured plant tissue.

See Cantaloup.

See Cantaloup.

See Cantaloup.

Same as for aphids on beans.

See Cantaloup.

See Cantaloup.

STRAWBERRY



12 times natural size.

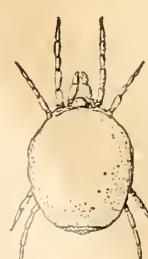
Strawberry weevil: Chestnut brown with 2 black spots on back; about $\frac{1}{10}$ inch long, with a doubled-under snout half as long as body.

Severs stem below fruit bud, allowing no fruit to form.

Damages strawberries in the Eastern States, particularly in the midseason and late-producing areas.

Dust with a mixture of 1 pound of cryolite and 3 pounds of dusting sulfur, or 1 pound of calcium arsenate and 5 pounds of dusting sulfur. Do not use after fruits form. Begin treatment about the time first buds appear.

See warning regarding residues on page 1



40 times natural size.

Red spiders: Very small, reddish mites; feeding on underside of leaf.

Causes leaves to curl, discolor, become covered with webs, and die. Fruit and stems also attacked.

Widely distributed and may cause serious damage in some localities.

Dust with fine grade of sulfur. Apply the dust to undersides of the leaves.

Insect or Disease

Remedy

Flea beetles: Small, green, coppery, or blue beetles, about $\frac{1}{6}$ inch long. See flea beetles on beets for a picture of a smaller type of flea beetle.

Holes eaten in the leaves.

Widely distributed; may cause damage in certain localities.

Same as for strawberry weevil, but do not apply cryolite or calcium arsenate after first fruits form.

See warning regarding residues on page 1.



9 times natural size.

Strawberry leaf beetle: Nearly black to reddish yellow, sometimes with four darker spots on wing covers; $\frac{1}{2}$ inch in length. Eats holes in leaves, feeding at night.

Widely distributed and causes damage periodically in certain localities.

Same as above. Do not use after fruits form.

See warning regarding residues on page 1.



5 times natural size.

Strawberry root weevil: Very dark brown or almost black snout beetle, $\frac{1}{4}$ inch long. Eats off roots near the crown.

Widely distributed but is particularly destructive in berry-growing areas of the Western States.

Poisoned bait (poison bait 27, p. 26) dropped around plants when insect appears.

See warning regarding residues on page 1.

Leaf spot (fungus): Spots $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter, varying in color from brown to white with purplish border, depending on causative organism.

Occurs in almost all regions where strawberries are grown; most severe in Gulf States.

Not often serious. Spray with bordeaux mixture (spray mixture 8, p. 26) as soon as new spring growth starts, and repeat every 10 days until first berries are one-third grown. When making new planting, take off all old leaves and dip plants in bordeaux mixture. Cut off old leaves and burn them immediately after harvest.

Leaf variegation or June yellows (noninfectious): Leaves mottled or streaked with yellow. Occurs mainly on varieties Blakemore and Premier.

May occur wherever these varieties are grown.

No cure known. Do not use runner plants from affected mother plants, as they will also be variegated. When ordering plants of Blakemore and Premier, specify "yellows-resistant" strains.

Red stele (fungus): New leaves small, slightly bluish, with short petioles. Plants wilt and die about fruiting time. Fibrous roots die and larger live roots have red center. Fungus thrives in poorly drained soil. Occurs on Pacific coast and in the Central, Northeastern, and Middle Atlantic States.

Dig out and burn diseased plants. Fungus lives in the soil for several years; therefore it is inadvisable to replant on the same plot unless the highly resistant varieties Aberdeen or Pathfinder are used. All other varieties are susceptible. Some States have red stele plant inspection service and produce for shipment plants relatively free from the disease. Home gardeners should use disease-free plants for setting new plots.

Yellows and crinkle (viruses): Yellowing, dwarfing, crinkling, and twisting of leaves. Plants do not die, but berry crop is reduced.

The two diseases are prevalent in Pacific Coast States.

No cure known for diseased plants. Only disease-free plants should be set in new plantings. Rogue out any plants that show symptoms. All runner plants from a diseased mother plant have the disease.

STRAWBERRY—Continued

Insect or Disease

Berry rots (fungus): Decayed fruit varies in color and texture, depending on the organism causing the rot.
May occur wherever strawberries are grown.

Remedy

Spraying with bordeaux mixture (spray mixture 8, p. 26) will prevent some rot. Mulching to keep berries from contact with soil gives good control. Space plants 6-8 inches apart to prevent shading of berries. Avoid use of nitrogenous fertilizers in spring that will stimulate heavy growth of foliage.

SWEET CORN



A little less than natural size.



Slightly more than natural size.

Corn earworm: Green or brown, with light stripes along sides and back. This same insect is called the tomato fruitworm when it is found on tomatoes.
Eats corn kernels near the tip of the ear after entering through the silk.
Damages corn during some part of the season wherever it is grown in the United States.

Inject $\frac{1}{4}$ teaspoonful of medicinal mineral oil into the base of the silk mass (fig. 9, p. 30) with an oil can or a medicine dropper ($\frac{1}{2}$ average dropperful) as soon as the silks have become wilted, or about the fourth day following silk exposure. Some insecticide companies can supply the oil with an insecticide added, which is especially prepared and more effective for corn earworm control.

European corn borer: Pale-colored worm tinged with pink and brown, about 1 inch long.
Feeds in stalks and ears of corn.
Distributed in Eastern and North Central States from North Carolina northward to Maine and westward to Iowa and may cause serious damage to sweet corn in certain areas.

Spray with rotenone (spray mixture 5, p. 25) when the first-laid eggs begin to hatch. Use about $1\frac{1}{2}$ gallons per 100 stalks, applying to center of leaf whorls and ear shoots until the spray runs off at base of plant. Repeat at least 3 times at 5-day intervals. Rotenone dust (dust mixture 18, p. 25) thoroughly applied to center of leaf whorls and ear shoots, following same schedule as for sprays, is also useful.

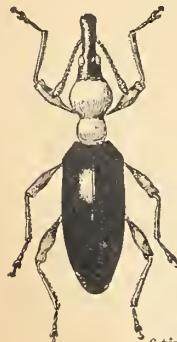
Seed-corn maggot: See Beans.

See Beans.

Bacterial wilt: Plants are dwarfed and may wilt and dry up. Tassels turn white early. If stalks are cut, there is a yellow, slimy, bacterial ooze. May be carried on seed and also is carried over winter by insects that also spread the disease in the field.
Common in Central, Southern, and Eastern States.

Use resistant varieties, such as Stowell's Evergreen, Golden Cross Bantam, Marcross, Spancross, or Whiperross; other quite resistant varieties are listed by seedsmen. Most of the white late varieties are somewhat resistant.

SWEETPOTATO

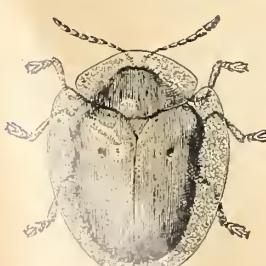


6 times natural size.

Sweetpotato weevil: Adult, $\frac{1}{4}$ inch long, a shiny, antlike, slender-bodied snout beetle, with blue-black head, wing covers, and abdomen; legs and middle of body bright red. Grub, $\frac{3}{8}$ inch long, legless, white, with pale-brown head.

Plant clean roots. After harvest destroy plants and tubers that are infested. Spray with calcium arsenate (spray mixture 1, p. 25) or dust with calcium arsenate (dust mixture 14, p. 25) at 10-day intervals. Keep plants well hilled with soil.

Grubs tunnel potatoes and vines.
Damages crop along the Gulf Coast, and in southern Texas, Georgia, and Florida.



5 times natural size.

Tortoise beetles: Either golden hued, spotted, striped, or mottled, tortoise-shaped or flat-oval bodied.
Eat holes in the leaves or destroy them entirely.
Widely distributed.

Dust with undiluted calcium arsenate, or cryolite (dust mixture 15, p. 25). Rarely become abundant enough to require treatment of crop.

Stem rot (fungus): Yellowing and wilting of plants. When cut across, the stems show a black discoloration and roots show a black ring. Caused by a fungus which enters and grows in the water vessels of roots and stem.
Common wherever sweetpotatoes are grown.

In buying plants make sure that they have clean, white roots. Any plants that fail to grow normally and have yellowed leaves should be destroyed. Do not plant on the same land each year.

SWEETPOTATO—Continued

Insect or Disease

Remedy

Black rot (fungus): Produces black, sunken, roundish spots of various sizes on the sweetpotato and black cankers on underground parts of the stems. Fungus lives over in diseased roots and attacks slips in the plant bed. Spreads in storage.
Common wherever sweetpotatoes are grown.

Same as for stem rot.



A little less than natural size.

Tomato fruitworm: Green or brownish worm up to $1\frac{1}{4}$ inches long with light stripes. Eats holes in fruit and buds. Widely distributed. Damages tomato in Southern States and in California annually; periodically causes losses by fruit damage in other States.

Dust with undiluted ealeium arsenate, or cryolite (dust mixture 15, p. 25); or apply poisoned bait (poisoned bait 25, p. 26) when plants are 1 to 2 feet across, or as soon as fruits of main crop begin to set. Repeat at 2-week intervals until 3 applications have been made.

See warning regarding residues on page 1.

TOMATO



About $\frac{1}{3}$ natural size.

Colorado potato beetle: See Potato.

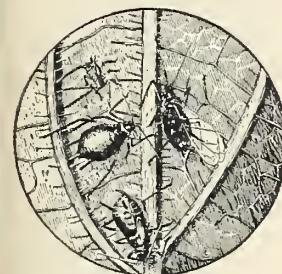
Same as for this insect on eggplant.

Hornworms: Large, green worms, with "horn" on back end of body. Defoliate plants. Widely distributed; in some areas cause serious damage.

Hand-pick.

Flea beetles: Small, black, brown, or striped beetles; very active, jump like fleas. See flea beetles on beets for a picture of one of the black type of flea beetles. Eat small holes in leaves. Widely distributed and may damage young tomatoes wherever grown.

Same as for flea beetles on potato. Since these insects are particularly destructive to newly transplanted tomatoes, especially if plants wilt from lack of water, treat when plants are set out and transplant at a period when newly set plants will not suffer from lack of moisture.



5 times natural size.

Aphids: Small, green, sucking plant lice. Leaves curl; plant yellowed. Tomatoes grown in the Eastern States are subject to aphid infestation to a greater extent than those grown elsewhere. However, damage occurs only locally in this region.

Same as for aphids on beans.

Damping-off (fungus): Seed decay and wilting and death of very young seedlings.

Treat seed with red copper oxide, Semesan, Sperton, or Arasan (p. 27).

Early blight (fungus): Numerous brown spots on leaves which enlarge into circular spots with targetlike markings. Stems show brown cankers which may girdle seedlings at ground line (collar rot). Fruits may develop dark, leathery, decayed spots at stem scar. Fungus lives in soil and may be carried on seed. Worst in warm, moist weather.

Common in all but semiarid regions.

Treat seed with liquid Semesan (p. 27). Never use seedling plants showing stem cankers or leaf spots. Garden tomatoes will commonly show some leaf spot, but spraying or dusting usually is not necessary. Copper sprays or dusts (p. 28) will check the disease to some extent.

Leaf spot (fungus): Leaves show many small spots with light centers and dark margins. Centers of spots are covered with tiny, dark specks. Severely diseased leaves are killed and crop may be reduced. Fungus lives in soil and on weed hosts. Worst in warm, moist weather. Common in North Central, Northeastern, and Southeastern States.

Remove or turn under all dead tomato vines in fall. Rotate crop. Destroy all jimsonweed, horsetail, and groundcherry plants in vicinity of garden. When leaf spotting appears early in season, spraying or dusting with copper fungicides (p. 28) is an aid in checking its spread.

TOMATO—Continued

Insect or Disease

Fusarium wilt (fungus): Gradual yellowing and wilting of the foliage, beginning with the lower leaves. Plants may eventually die, and yield is greatly reduced. Browning of the woody tissue just under the outer green portion of the stem is characteristic of the disease. Caused by fungus which lives for many years in the soil. May occur wherever tomatoes are grown but is most common in Southern States.

Mosaic (virus): Green and yellow mottling of foliage, which is often curled and slightly dwarfed. Plants stunted if infected early in the season. Caused by same virus as tobacco mosaic, which lives over winter in certain weeds and is often present in manufactured tobacco. Spread by handling or brushing plants and by plant lice. Virus is not carried in seed and does not live long in soil.

Common throughout the United States.

Anthraenose (fungus): Ripe fruits show circular, sunken, water-soaked spots which become dark at margins, with lighter centers covered with dark specks in concentric rings. Most serious in warm, moist weather.

Common in Central and Middle Atlantic States.

Blossom-end rot (physiologic): Fruits develop large, dark, sunken, leathery spots at the blossom end. Occurs as a result of an insufficient supply of water for both foliage and fruit.

Found wherever tomatoes are grown, particularly during or just after periods of drought.

Root knot (nematode): Great numbers of gall-like swellings on roots. Plants yellowed and stunted. Caused by minute nematodes (eelworms) in soil.

Most common in Southern States.

Remedy

Spraying or dusting is of no value. Use resistant varieties such as Marglobe, Rutgers, Pritchard, Break O'Day, or Pan America, which is particularly resistant.

Spraying or dusting is of no value. Avoid handling young plants unnecessarily and do not smoke while working with seedlings, since smokers may carry virus on their hands. Washing hands with soap and water removes virus. Keep down weeds in and about the garden.

Pick fruit as soon as it ripens. Proper fertilization and drainage aid in reducing losses. Spraying or dusting with copper fungicides (p. 28) may be of some value in control.

Avoid excessive use of nitrogenous fertilizers, particularly stable manure, and use ample quantities of superphosphate. If garden is watered, maintain an even supply of moisture in soil.

Rotate crop and avoid land known to be heavily infested with nematodes. Grow seedlings in nematode-free soil. Burn roots of diseased plants.

TURNIP

Aphids: Small, greenish, sucking plant lice, on under side of leaves. Generally similar to the aphids found on tomato. See illustration there.

Leaves curl, yellowing plants.

Turnips wherever grown are subject to aphid infestation, but aphids are particularly destructive in the Southeastern States.

Flea beetles: Small black or striped beetles; jump like fleas.

Small holes eaten in leaves. Destructive in the seedling stage.

Wherever turnips are grown they are subject to injury by flea beetles.

Same as for aphids on peas. Treatment should begin early to prevent infestations from building up.

Same as for flea beetles on beets.

See warning regarding residues on page 1.

Same as for caterpillars on cabbage.

See Cabbage.

Same as for cabbage maggot on cabbage.



20 times natural size.

WATERMELON

Insect or Disease

Striped cucumber beetle: See Cantaloup.

Spotted cucumber beetle: See Cantaloup.

Aphids: Small, light-green to black, soft-bodied insects. Leaves curled, distorted, yellowed. Not so subject to injury by aphids as is cantaloup, but injury may occur wherever watermelons are grown.

Remedy

See Cantaloup.

See Cantaloup.

Same as for aphids on beans.
Do not use sulfur on watermelon vines.

Anthracnose:

See Cantaloup. Spray with bordeaux mixture (spray mixture 8, p. 26).

Wilt (fungus): Stunting and death of seedlings and wilting of older plants beginning at tips of runners and spreading throughout the vine. Fungus lives indefinitely in soil and is carried on seed. Not identical with bacterial wilt of cucumber and muskmelon.

Severe in South and in some parts of Central States.

Where wilt occurs use resistant varieties such as Improved Kleckley No. 6, Improved Stone Mountain No. 5, Hawkesbury, Leesburg, or Blacklee. Do not plant on wilt-infested soil; rotate crop.

GENERAL FEEDERS

Ants: Small insects ranging from less than $\frac{1}{16}$ inch to $\frac{1}{2}$ inch or more in length. Many different colors represented, including black, brown, yellow, and red. Three distinct body segments. Ordinarily live in colonies.

In many cases ants do not cause real damage in vegetable gardens, but their presence is annoying. In some instances, however, they feed on and injure seriously the leaves, stems, fruits, or roots of growing vegetables. In addition, their activities around the roots of plants cause excessive drying of the soil and indirect injury to affected plants.

Widely distributed and may cause serious damage in some localities.

Use one of the ready-prepared ant baits in the form sold by dealers. Follow directions given on the package in which it is sold. When small anthills are numerous, scatter thinly a mixture made up of $\frac{1}{4}$ ounce of paris green and $\frac{1}{4}$ pound of brown sugar on soil surface at the rate of 1 ounce per 500 square feet. Some kinds of ants respond to some types of baits, and their response may vary from time to time; therefore, they are not easy to control.

Cutworms: Dull-gray, fat worms, $\frac{3}{4}$ to $1\frac{1}{4}$ inches long. Young plants cut at surface of ground. Cutworms occur in all sections of the country and are particularly destructive during the early part of the season.

Use poison bait (poison bait 24, p. 26) scattered lightly at base of plants. A collar of stiff cardboard rolled and set in the soil around the stem of transplants, such as cabbage or tomatoes, will aid in preventing cutworm injury. The collar, when in place, should be about $\frac{1}{2}$ inch distant from the plant stem and should extend about 1 inch below and 2 inches above the soil (fig. 10, p. 30).

Grasshoppers: Of many species, all with strong hind legs for jumping; most forms strong fliers. Feed on any available vegetation, and when abundant may destroy a complete planting. Widely distributed, but especially troublesome some in the Central Northwest.

Use poisoned bait (poisoned bait 24, p. 26) scattered thinly over the ground about, but not on, the growing plants. Apply in the morning as the grasshoppers become active.



5 times natural size.



Slightly less than natural size of common species.



About natural size.

GENERAL FEEDERS—Continued

Insect



3 times natural size.

Japanese beetle (as a vegetable-garden pest): The parent, or beetle, is oval, nearly $\frac{1}{2}$ inch long, about $\frac{1}{4}$ inch wide, and shining metallic green. Outer wings are coppery brown. The fully-grown grub, or larva, is about 1 inch long, with a white body and a brown head.

This insect is a general feeder. Among the vegetables, the beetles are most likely to feed on the foliage of beans, asparagus, and rhubarb and on the silk and foliage of sweet corn. Grubs feed on the roots of various plants, including bean, tomato, beet, sweet corn, onion, and strawberry. Present in destructive abundance in many localities from southern New England to Virginia and eastern Ohio.

Remedy

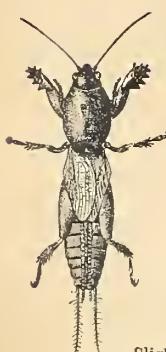
In the home garden the susceptible vegetables, such as string and lima beans, rhubarb, and asparagus, can be protected from injury by the beetles by dusting the plants thoroughly with a good grade of fine hydrated lime as often as necessary to maintain a good deposit. When rotenone-containing insecticides are used on beans for Mexican bean beetle control these insecticides also give fair protection against the Japanese beetle on this crop. The ears of sweet corn can be protected from serious beetle attack by dusting the tips of the ears with very fine hydrated lime 2 or 3 times at 3-day intervals early in the silking period. Ordinarily the grubs do not cause serious losses to vegetable crops. Carefully working the soil in the fall or spring and killing the larvae that are found or permitting chickens to run in the garden until seeding time is useful in controlling the grubs.



About natural size.

Millipedes: Brown or grayish, hard-shelled, wormlike creatures, 1 to $1\frac{1}{4}$ inches long. Feed on roots, tubers, bulbs, and fleshy stems of plants and on seeds planted in soil. Found commonly under shelter, such as boards or flowerpots, or in decayed manure. Widely distributed.

Apply bait (poisoned bait 24, p. 26) to infested premises. The sugar and paris green mixture recommended for sowbugs is also effective, as well as drenching infested soil with pyrethrum (spray mixture 6, p. 25). Destroy or dispose of hiding places.



Slightly less than natural size.

Mole crickets: Light-brown insects, $1\frac{1}{2}$ inches long, faintly resembling field crickets. Large, beady eyes, and short, stout front legs bearing shovellike feet. Make burrows in upper inch or two of soil, like those of a small ground mole. Up-root seedlings. Destructive types of mole crickets occur in the coastal areas of North Carolina, South Carolina, Georgia, Alabama, and Mississippi and in Florida.

Use poisoned bait (poisoned bait 26, p. 26) scattered lightly in all infested parts of garden. For best results apply bait in late afternoon following a rain or artificial application of water.



Less than natural size.

Slugs and snails: Slugs as illustrated are black, shiny snails without shells. Eat leaves of small plants at night. Leave a glistening, slimy trail. Widely distributed and are particularly destructive on the West Coast.

Dust soil in infested parts of garden with hydrated lime. Spray plants with bordeaux mixture (spray mixture 8, p. 26), and use poisoned bait (poisoned bait 24, p. 26). Use commercially-prepared baits containing metaldehyde.

GENERAL FEEDERS—Continued

Insect

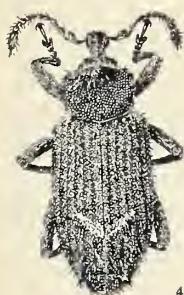


Twice natural size.

Sowbugs or pillbugs: Dark-gray, oval, flattened bodies, with seven pairs of legs, $\frac{1}{2}$ inch long. Not true insects. Feed upon roots and tender parts of plants. Found in same situations and territory as millipedes.

Remedy

Sprinkle surface of infested soils with a dry mixture made up at the rate of 9 ounces of sugar and 1 ounce of paris green; or a mixture of 2 ounces of wheat flour, 2 ounces of sugar, and 1 ounce of paris green. Spray infested soil with nicotine sulfate (spray mixture 4, p. 25) or pyrethrum (spray mixture 6, p. 25).



4 times natural size

Vegetable weevil: Dull grayish-brown weevil $\frac{3}{8}$ inch long, with 2 oval pale-gray marks on back. Larvae, or grub, $\frac{3}{8}$ inch long, with light-green body and light-yellow to brown head.

Weevils and grubs feed on leaves and roots of many vegetables, including turnips, carrots, mustard, spinach, tomatoes, and potatoes.

Has been destructive in the Southern States and in limited coastal areas of California.

Use poisoned bait (poisoned bait 28, p. 26) scattered lightly on soil surface along edge of garden or between rows of plants. Ready-prepared baits containing sodium fluosilicate and finely ground apple pulp, in the form sold by dealers, are also suitable for this purpose. Susceptible crops with foliage that is ordinarily not eaten by humans can be protected from injury by calcium arsenate spray (spray mixture 1, p. 25), or undiluted calcium arsenate dust, or by a cryolite spray (spray mixture 2, p. 25) or cryolite dust (dust mixture 15, p. 25).



About natural size.

White grubs: Large white or light-yellow grubs, $\frac{1}{2}$ to $1\frac{1}{2}$ inches long, with hard brown or black heads. Live entirely in soil during larval stage. Usually found in curved position.

Feed on roots or underground stems of plants and on potato tubers.

Widely distributed and may cause severe damage in some localities.

No remedy except prevention. Avoid abandoned or newly plowed grassland. If white grubs are found when spading or plowing the garden, sow an extra quantity of seed and thin out later. Plow or spade deeply in the late fall or during winter, if weather conditions permit.



About natural size.

Wireworms: Slender yellow to white worms, with dark head and tail, resembling a jointed wire.

Puncture and tunnel stems and roots.

Widely distributed and are more destructive in some areas than in others; particularly destructive in irrigated lands of Western States.

Apply crude naphthalene flakes to soil surface, at rate of 1 ounce to each $5\frac{1}{2}$ square feet. Spade or plow under 7 to 12 inches deep; follow by deep harrowing. Do not plant until 7 days after treatment. Avoid planting very susceptible crops in soils infested with wireworms. Deep cultivation in midsummer and heavy fertilization will help counteract wireworm damage.

Although many of the control measures recommended in this publication include the use of insecticides and fungicides, there are other generally useful practices, such as those given in the following paragraphs, that aid in the control of insects and diseases attacking vegetables and do not require the use of insecticides or fungicides.

INSECT CONTROL—GENERAL METHODS

Small seedlings may be protected from insects, excepting those living in the soil, by covering the plants with an inverted glass jar or completely covering them with a light paper or muslin hood. Such hoods are usually about 8 inches in diameter and are supported by wire or wooden hoops and sealed to the ground by covering the edge of the hood with soil.

Hand picking of the larger beetles, caterpillars, and plant bugs will often give satisfactory control in a small garden and eliminate the need for applying insecticides. Hand picking is most effective if begun early enough to catch the first insects attracted to the vegetables.

DISEASE CONTROL—GENERAL METHODS

Plant diseases can rarely be cured, but it is possible to prevent their occurrence and spread. Disease control should begin with the seed and continue until harvest. The control measures described in this section include directions for the preparation and use of the chemical seed treatments and sprays and dusts already mentioned.

Good Garden Practices

The methods of gardening essential to the production of good crops are also an aid in disease control. These practices include (1) the use of fertile, well-drained soils; (2) the proper application of fertilizers of a type suited to the soil and crop; (3) the planting of crops and varieties suited to the soil and climate; and (4) clean cultivation.

Sanitation

At the end of the season all diseased crop refuse, including the roots, should be disposed of by burning. Do not compost the remains of diseased plants. Keep down weeds in the vicinity of the garden, since they may harbor disease-producing viruses or fungi. The garden should be so planned that the same crop or related crops, such as cabbage and cauliflower or tomatoes, peppers, and eggplant, are not grown in the same spot in successive years.

Obtain disease-free seed. Where certified seed is available, as with tomatoes and potatoes, endeavor to obtain it. Cabbage, cauliflower, bean, and pea seed grown in the far West is ordinarily free from certain disease-producing organisms. Never save seed from decayed or spotted fruits or from wilted plants.

When seedling plants are purchased, make sure they do not show swellings on the roots, stem cankers, or leaf spots. If southern-grown tomato plants are used, it is best to buy State-certified plants.

Use of Resistant Varieties

Resistant varieties offer the most effective means of disease control, but such varieties are as yet available in the case of only a few diseases of certain crops. The number of highly resistant varieties is also limited, but a larger group of disease-tolerant varieties exists, and these, while not entirely resistant, are comparatively slightly injured. Valuable examples of resistant varieties are available in cabbage, tomato, watermelon, beans, peas, and potatoes; and the names of many of these varieties are given in the lists of diseases. For a further list consult United States Department of Agriculture Leaflet 203, Disease-Resistant Varieties of Vegetables for the Home Garden.

Seed Treatment

Chemical seed treatments are used for two purposes, (1) protection against decay of seed in the soil and the damping-off of small seedlings, and (2) the disinfection of the seed to kill any parasitic fungi or bacteria that may be present on its surface (p. 27). The same treatment, however, does not necessarily serve both purposes. It must also be remembered that seed treatment does not insure the freedom of the plant from all diseases, although it is a very valuable means of disease control.

HOW TO PREPARE INSECTICIDES AND FUNGICIDES FOR GARDEN-PEST CONTROL¹

INSECTICIDES

The following formulas and directions are given for the preparation of spray and dust mixtures and poisoned baits needed for the control of the more common insects and related pests attacking vegetables in farm, suburban, city, and community gardens, as listed in this publication. These directions have been made as simple and as uniform as possible, with due regard to the saving of insecticides, such as rotenone and pyrethrum, which have been made scarce by war conditions. Small measures are given for each of the ingredients in order to guide the gardener in preparing small quantities of the finished insecticide.

¹ Before attempting to prepare any of these insecticides or fungicides, refer to the warnings given on p. 1 and read them carefully.

Spray mixture 1: CALCIUM ARSENATE:

Calcium arsenate	1 ounce (5 level table-spoonfuls).
Hydrated lime	3 ounces.
Water	1 gallon.

Spray mixture 2: CRYOLITE:

Cryolite	1 ounce (8 level tea-spoonfuls).
Water	1 gallon.

Do not use lime or bordeaux mixture with cryolite.

Spray mixture 3: PARIS GREEN:

Paris green	2 level teaspoonfuls.
Hydrated lime	3 level tablespoonfuls.
Water	1 gallon.

Spray mixture 4: NICOTINE SULFATE:

Nicotine sulfate (40 percent) ²	1 tablespoonful.
Soap (mild laundry type)	1 cubic-inch cake (or 2 level tablespoonfuls of soap flakes).
Water	1 gallon.

Dissolve soap in 1 pint of warm water. Add nicotine sulfate. Stir this mixture and add enough water to make 1 gallon.

Spray mixture 5: ROTENONE:

Derris or cube root powder (5 percent rotenone content)	½ ounce (3 level table-spoonfuls).
Water	1 gallon.

If the available powder is of lower rotenone content, use proportionally more of it.

Mix the powder first with a small quantity of water, then add it to the rest of the water in the sprayer.

Spray mixture 6: PYRETHRUM:

Use a ready-prepared pyrethrum spray material at the dilution given on the package in which it is sold.

Spray mixture 7: NICOTINE-PYRETHRUM:

Add 1 tablespoonful of nicotine sulfate (40 percent) to 1 gallon of water containing spray mixture 6. Mix thoroughly. Stir well all spray mixtures during their preparation, and where a powder and liquid are mixed together, shake the sprayer from time to time during the spraying unless the sprayer is provided with an agitator.

Dust mixture 14: CALCIUM ARSENATE:

Calcium arsenate	1 pound.
Hydrated lime	2-3 pounds.

Place the materials in a tight can or similar container. Add several stones 1 inch in diameter to aid mixing process. Place tightly fitting cover on can. Shake or rotate can for 5 minutes. Remove stones by passing mixture through sifter or screen.

Dust mixture 15: CRYOLITE:

Cryolite	2 pounds.
Talc	1 pound.

Do not use lime or bordeaux mixture with cryolite.

Dust mixture 16: PARIS GREEN:

Paris green	1 pound.
Hydrated lime	10 pounds.
Mix by same method as dust mixture 14.	

Dust mixture 17: NICOTINE SULFATE (3 percent):

Nicotine sulfate (40 percent)	1 ounce (5 teaspoonfuls).
Hydrated lime	1 pound.

Sift lime to break up lumps. Put sifted lime in tight can. Add several stones 1 inch in diameter to aid mixing process. Pour nicotine sulfate over lime. Place tight-fitting cover on can. Shake or rotate can for 5 minutes. Remove stones by passing mixture through sifter or screen.

Dust mixture 18: ROTENONE:

Use a ready-prepared dust mixture containing at least 0.75 percent of rotenone in the form sold by the dealer.

Dust mixture 19: PYRETHRUM:

Use a ready-prepared pyrethrum dust or dust mixture in the form sold by the dealer. Follow directions given on the package in which it is sold.

To prepare a home-made pyrethrum dust mixture use—

Ground pyrethrum flowers (1.3 percent total pyrethrins content)	1 pound.
Talc, pyrophyllite, or tobacco dust	3 pounds.

Mix by same method as dust mixture 14 (above).

Dust mixture 20: NICOTINE-PYRETHRUM:

Mix thoroughly equal quantities of dust mixtures 17 and 19.

² The strong nicotine sulfate solution (40 percent) is very poisonous, and care should be taken not to get it on the skin or about the eyes or mouth.

Spray mixture 8: BORDEAUX MIXTURE:

Bluestone (copper sulfate)	4 ounces.
Hydrated lime	4 ounces.
Water	3 gallons.

Dissolve the bluestone in a wooden, earthenware, or glass vessel (*never in metal*), using hot water. Dilute with half the total water specified. Make a paste of the lime in a small quantity of water, and add the rest of the water to this. Pour the diluted bluestone and lime solutions together and mix thoroughly. Strain the mixture through a fine cheese-cloth directly into the sprayer, and it is ready for use.

This mixture should be made fresh each time it is used.

Spray mixture 9: B O R D E A U X MIXTURE—CALCIUM ARSENATE:

Add 3 ounces of calcium arsenate to 3 gallons of bordeaux mixture, made according to directions just given. Mix thoroughly.

Spray mixture 10, which was described in Miscellaneous Publication 525, is no longer recommended.

Spray mixture 11: TARTAR EMETIC:

Tartar emetic	1 ounce (6½ level teaspoons).
Brown sugar	2 ounces (6 tablespoonfuls).
Water	3 gallons.

Four tablespoonfuls of syrup or molasses may be substituted for the brown sugar.

Dissolve the sugar or syrup in a small quantity of water. Add the tartar emetic slowly while stirring the water. Then dilute with quantity of water required to make 3 gallons. This solution should be made fresh each time it is used.

Spray mixture 12: SOAP:

Soap (mild laundry type)	2 ounces (4 cubic-inch cakes or 8 level tablespoonfuls of soap flakes).
Water	1 gallon.

Cut cake soap into very small pieces. Dissolve soap in quart of hot water. Let cool. Add sufficient water to make 1 gallon. Use half strength on very tender plants such as young cabbage, garden peas, and beans.

Solution 13: CORROSIVE SUBLIMATE:

Corrosive sublimate (mercuric chloride)	½ ounce (six 7½-grain tablets).
Water	1 gallon.

Dissolve the corrosive sublimate in a pint of hot water in a glass or earthenware vessel. Then dilute with quantity of cold water required to make 1 gallon.

Calomel (mercurous chloride) may be substituted for corrosive sublimate at the rate of ½ ounce to 1 gallon of water.

Dust mixture 21: SULFUR-PYRETHRUM:

Dusting sulfur	1½ pounds.
Pyrethrum flowers (1.3 percent total pyrethrins content)	1 ounce (5 tablespoonfuls).

Do not use sulfur on squashes, melons, or cucumbers.
Mix by same method as dust mixture 14 (p. 25).

Dust mixtures 22 and 23, which were described in Miscellaneous Publication 525, are no longer recommended.

Poisoned bait 24: CUTWORM AND SLUG BAIT:

Sodium fluosilicate or paris green	¼ pound.
Dry, flaky wheat bran	5 pounds (1 peck).
Water to moisten	3 or 4 quarts.

Mix thoroughly the poison and the dry bran. Then moisten the mixture with water until each flake of the bran has been wetted. Prepare this bait in the morning and apply it late in the day, so that it will be moist and attractive when the cutworms begin to feed in the evening. Scatter the bait lightly and evenly on the soil surface of the garden or around the bases of plants that have been set out. Repeat application, if necessary.

Poisoned bait 25: TOMATO FRUITWORM BAIT:

Cryolite	½ pound.
Corn meal	5 pounds.

Sift corn meal to break up or remove all lumps. Put one-fourth of corn meal in bucket or similar container. Add one-fourth of poison to corn meal. Mix thoroughly. Repeat process until entire quantity is mixed. Scatter the bait lightly and evenly over the leaves of tomato plants, especially the fruit clusters, growing tips, and outer leaves.

Poisoned bait 26: MOLE CRICKET BAIT:

Sodium fluosilicate	½ pound.
Dry wheat bran	5 pounds (1 peck).
Water	1 to 2 pints.

Mix by same general method as poisoned bait 24, but add only sufficient water to the dry bran and poison to cause the bait particles to cling together when squeezed in the hands. Scatter the bait lightly and evenly on the soil surface of infested gardens.

Poisoned bait 27: STRAWBERRY ROOT WEEVIL BAIT:

Calcium arsenate	½ pound.
Dry wheat bran	5 pounds (1 peck).
Water	2 quarts.

Mix by same method as poisoned bait 24. Scatter bait lightly and evenly around plants as soon as presence of insect is detected.

Poisoned bait 28: VEGETABLE WEEVIL BAIT:

Sodium fluoride	½ pound.
Fresh, finely chopped carrots or turnips	4 pounds.
Dry wheat bran	7 pounds.
Water to moisten	3 or 4 quarts.

Mix bait by method described for poisoned bait 24. Then mix chopped vegetables with the prepared bait. This bait is more attractive to the weevils if allowed to stand several hours before it is applied. Apply in the late afternoon. The bait is effective only late in the winter and in the spring, since at other times of year the weevils prefer growing crops.

Treatments for Prevention of Seed Decay and Damping-Off

Seed decay and damping-off can be controlled by dusting the seed with various chemical compounds, some of which are listed below. Farmers' Bulletin 1862, *Vegetable Seed Treatments*, gives a more complete list of seed treatments and the details of their use with various crops. The treatments here described are generally effective, except as noted. The amount of dust needed for treating seed for even a large garden is so small that it will avoid wastage of valuable material to purchase the smallest package available and endeavor to share that with neighbors. In treating seed the dust and seed are placed in a closed container and shaken for 3 to 4 minutes, after which any excess dust is screened off and the seed is ready to plant. The following dusts give effective seed protection and aside from the exceptions noted may be used on any of the vegetable crop seeds where their use is not specifically mentioned.

Semesan.—An organic mercury compound which can be used on all vegetable seeds except lima bean. Directions for its use on various seeds come with the package.

Red copper oxide.—Red oxide of copper (Cuproicide) is commonly used for control of damping-off. It should never be used on cabbage, cauliflower, or related plants, or on onion seed or sets, or lima beans. Use as directed by the manufacturer. From one-fourth to one and one-half level teaspoonsfuls are sufficient for a pound of seed, depending on the size of the seeds.

Spergon and *Arasan*.—These are compounds containing no mercury or copper which can be used on practically all vegetable seeds with good results. Spergon is effective on beans and peas. Use as especially directed by makers.

Seed Disinfectants

Various chemicals are used to destroy disease-producing organisms on the seed surface. Those here listed are generally effective when used as recommended. A more complete list is given in Farmers' Bulletin 1862, mentioned above. It is advisable to consult your county agent or State agricultural college if in doubt as to what to use on any crop.

Corrosive sublimate.—Some seed-borne organisms often can be controlled by treating the seed with a corrosive sublimate solution. This is used at various strengths as shown below. The seed is placed in a loose cloth bag and soaked for the time indicated. This chemical corrodes metal and must be used in earthenware, glass, or wooden containers. After the seed has been soaked it should be rinsed in running water or in several changes of water and dried at once. A 1:1,000 solution of corrosive sublimate

(1 ounce to $7\frac{1}{2}$ gallons of water) is usually used, and this can be made in small quantities by dissolving one of the prepared tablets sold by druggists in 1 pint of water. A 1:1,500 solution is prepared by using one tablet to $1\frac{1}{2}$ pints of water. One tablet to 1 quart of water gives a 1:2,000 solution. Treat the seed as follows:

Cucumber, muskmelon, and watermelon: Soak seed 5 minutes in a 1:1,000 solution.

Eggplant: Soak seed 10 minutes in a 1:1,000 solution.

Pepper: Soak seed 2 minutes in a 1:1,000 solution.

Tomato: Soak seed 5 minutes in a 1:2,000 solution.

After treating any kind of seed, wash the seed for 15 minutes and dry it at once.

This treatment does not protect against damping-off, and if this protection is desired, the seed must be given a second treatment with one of the chemical protectants listed above.

Semesan.—A solution of Semesan in water can be used as a disinfectant for most vegetable seeds. The solution should be made according to the directions accompanying the package.

Spraying and Dusting

The use of sprays or dusts is of value in the control of many leaf-blight diseases, but only those parts of the plant are protected that are thoroughly coated with the material. Sprays often stick better than dusts and can be applied in light winds. On the other hand, dusts are easier to apply and the equipment is less expensive and requires less attention to keep it in working order. For the small garden, dusting is probably the more satisfactory method.

Many diseases are not controlled by sprays or dusts and there are many other diseases which frequently are not damaging enough to require spraying. Potatoes, celery, cucumbers, and melons commonly require the use of fungicides, but a number of other crops rarely require their use. The fungicides listed below are those generally recommended for vegetable crops.

Copper Sprays

Bordeaux mixture.—Bordeaux mixture is the copper spray in most common use and one of the most effective. It can be prepared in 3-gallon quantities as given on page 26. It should always be freshly prepared, as it will not keep from one day to the next. Always wash the sprayer well after use.

Prepared bordeaux can be purchased in convenient packages and is often most satisfactory for a very small garden, but the freshly prepared mixture is more effective and less expensive. Consult the section on Insecticides (p. 26) for directions as to combining an insecticide with bordeaux mixture.

Fixed copper sprays.—"Fixed" or "insoluble" copper sprays are on the market and are preferable to bordeaux mixture for tomatoes, cucumbers, and muskmelons, since they cause less damage to the foliage. They should be used as recommended by the manufacturer.

Copper Dusts

Copper-lime dust.—A dust composed of 20 parts of monohydrated copper sulfate and 80 parts of hydrated lime is often used on vegetable crops. It can be purchased ready mixed. This mixture should be applied when the foliage is wet.

Fixed copper dusts.—The fixed copper compounds mentioned above are often mixed with various inert materials and used as dusts. They are effective on many crops and can be purchased from dealers in agricultural supplies.

Sulfur Dusts

Sulfur dusts especially prepared for use on plants may be used for the control of powdery mildew of beans and sometimes bean rust. They are also of value in controlling some insects. *They should not be used on cucumbers or melons, as they are very damaging to these crops. For the treatment of a disease, sulfur should not be used unless it is recommended for this purpose.* Most vegetable diseases are best controlled by copper fungicides.

DDT INSECTICIDES

Insecticides containing DDT are available in four general types: (1) *Powders* to apply as a dust, (2) *wettable powders* or powders that will mix readily with water for spraying, (3) *emulsions* to be diluted with water and applied as a spray, and (4) *solutions* to be applied without further dilution. Of these four types the dusting powder and wettable powders are safest for use on plants, and the gardener interested in using DDT will find these powders suitable. DDT solutions are primarily for use against household pests and should not be applied to plants or animals. DDT emulsions may cause damage to some kinds of plants and, unless expert advice and supervision are available, they should not be used by the home gardener.

DDT will satisfactorily control various types of garden pests, but it is not a satisfactory remedy for some others, notably the Mexican bean beetle, some types of aphids, and red spider mites. DDT dust and wettable powders should not affect the growth of most vegetables; however, pumpkins and squash appear to be susceptible to the action of DDT. Isolated cases of injury to peas and tomatoes, apparently due to some local factor, have been reported.

Experimental work to date shows that DDT is poisonous to higher animals and man and therefore its usage in the garden on leafy vegetables is limited. See "Warning Regarding Poison Residues" on page 1.

A dust mixture containing 3 percent of DDT is effective against the Colorado potato beetle, the potato flea beetles, potato and bean leafhopper, cabbage looper, the imported cabbage worm, the diamond-back moth larva, and some species of cutworms which feed on the foliage of cabbage. A higher strength of dust will be needed for the control of aphids on potatoes and thrips on onions.

While the indications are that DDT dust mixtures which contain at least 5 percent of DDT will kill the immature forms of squash bugs, as stated above, DDT has injured squash and pumpkins and may stunt the growth of other crops belonging to the same plant family.

The DDT content of commercial wettable powders varies; therefore, in their use the directions of the manufacturer should be followed.

TABLES OF MEASURES

The following tables of measures will be found convenient in preparing small quantities of insecticides for the garden:

Liquid measure:

3 *teaspoonfuls* = 1 *tablespoonful*.
2 *tablespoonfuls* = 1 *fluid ounce*.
16 *tablespoonfuls*
or
8 *fluid ounces* = 1 *cup*.
2 *cups* = 1 *pint*.
2 *pints* = 1 *quart*.
4 *quarts* = 1 *gallon*.

Approximate quantities required to weigh 1 ounce:

1 ounce of calcium arsenate	5 level <i>tablespoonfuls</i> .
1 ounce of copper sulfate powder	5 level <i>teaspoonfuls</i> .
1 ounce of corrosive sublimate powder	1 level <i>tablespoonful</i> .
1 ounce of cryolite	8 level <i>teaspoonfuls</i> .
1 ounce of hydrated lime	3 level <i>tablespoonfuls</i> .
1 ounce of nicotine sulfate	5 <i>teaspoonfuls</i> .
1 ounce of paris green	1½ level <i>tablespoonfuls</i> .
1 ounce of pyrethrum flowers or powder	5 level <i>tablespoonfuls</i> .
1 ounce of sulfur (dusting sulfur)	2½ level <i>tablespoonfuls</i> .
1 ounce of talc	3 level <i>tablespoonfuls</i> .
1 ounce of tarter emetic	6½ level <i>teaspoonfuls</i> .

QUANTITY OF SPRAYS OR DUSTS TO APPLY

Sprays.—For small gardens, approximately 1 to 1½ quarts of liquid spray is required per 50 feet of row for each application to plants of medium size.

Dusts.—For small gardens, approximately 1 to 1½ ounces of dust mixture is required per 50 feet of row for each application to plants of medium size.

SPRAYING AND DUSTING EQUIPMENT

The effectiveness of an insecticide or fungicide depends to a large extent upon the thoroughness of the application of the material. The most effective way of applying an insecticide or fungicide is by the use of either sprayers or dusters manufactured expressly for the purpose.

Sprayers

Hand Atomizers (fig. 1).—The hand atomizer is probably the most familiar type of equipment used in applying liquid insecticides, as it has been commonly used for applying fly sprays in the home. Its capacity is from ½ pint to 2 quarts and it is useful for spraying small plantings, although the under sides of the leaves of the plant are difficult to reach.

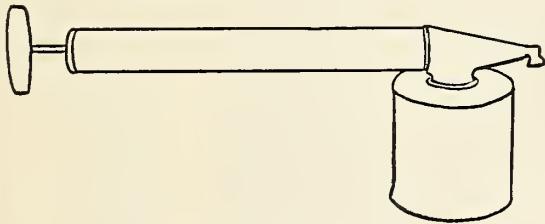


FIGURE 1.—Hand atomizer.

Compressed-air sprayers (fig. 2).—The compressed-air sprayer is the most satisfactory for the small garden, but its manufacture has been limited because of the shortage of metal. It is usually made of galvanized sheet steel and has a capacity of 1 to 5 gallons. Since these sprayers are not equipped with an agitator, it is necessary to keep the materials well mixed by shaking the tank frequently during the spraying operations.

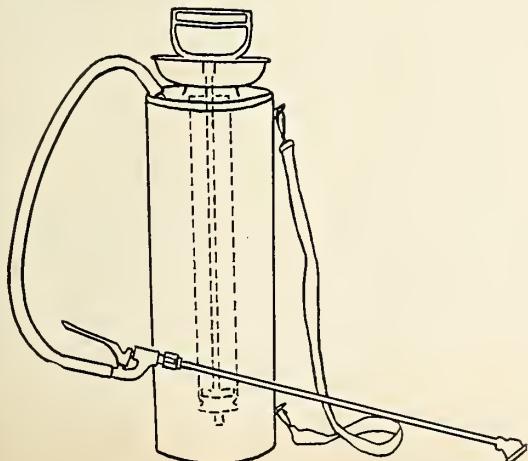


FIGURE 2.—Compressed-air sprayer.

Knapsack sprayers (fig. 3).—A knapsack sprayer is also a very useful piece of equipment for the home gardener. It costs more than the compressed-air sprayer but has an advantage over the compressed-air sprayer in that a higher and more uniform pressure can be maintained when the pump is kept in operation. An agitator is provided within the tank and operates with the movement of the pump handle.

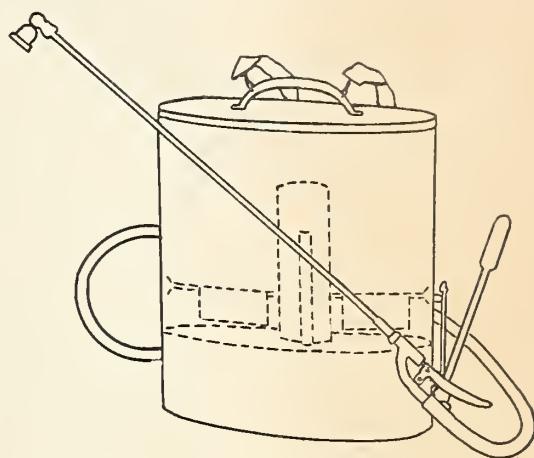


FIGURE 3.—Knapsack sprayer.

Bucket pump (fig. 4).—The bucket pump, or stirrup pump, was standard spray equipment prior to the war. The stirrup pump which has been manufactured and sold during the war period for fire-fighting purposes is not suitable for applying insecticides or fungicides without considerable modification as to nozzle and air chamber. It is necessary to have an air chamber in order to build up sufficient pressure, and a nozzle with a small opening to permit the spray to be applied in a fine mist. The most efficient operation of the bucket pump requires two persons—one to operate the pump and the other to manipulate the hose and nozzle.

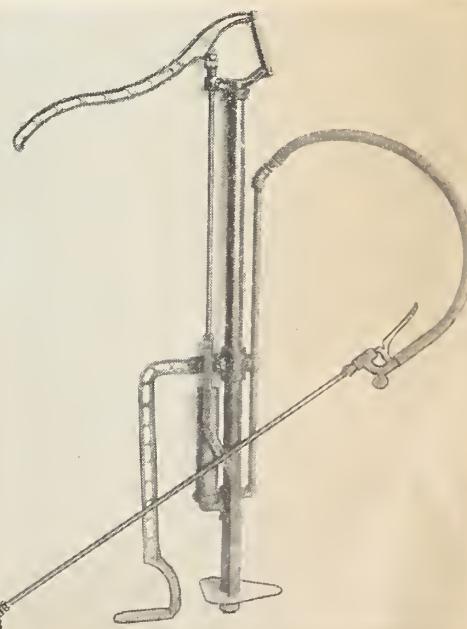


FIGURE 4.—Bucket pump with hose, extension rod, cut-off, and nozzle.

Dusters

Plunger type of duster.—The plunger type of duster (fig. 5), or dust gun, is the one most commonly manufactured for applying insecticides to small areas. Its dust-holding capacity ranges from 1 to 3 pounds. Prior to the war these dust guns were mostly of metal and equipped with metal or glass containers for the insecticide. The newer types placed on the market are made of wood and especially prepared paper. They are usually equipped with a tube and with a nozzle attachment that permits the dust to be directed to the under surface of the leaves.

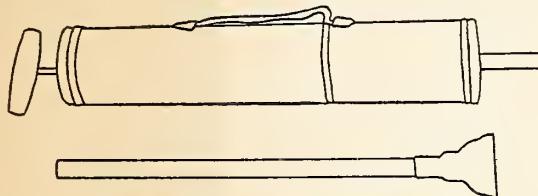


FIGURE 5.—Plunger type of hand duster.

Bellows type of duster.—Two types of bellows dusters are on the market. The smaller type (fig. 6) is made like the fireplace or blacksmith bellows, is equipped with special openings and a container for the dust or powder, and is satisfactory for small areas. The other type is the knapsack duster (fig. 7), which is satisfactory for applying insecticidal dust to both small and large gardens.

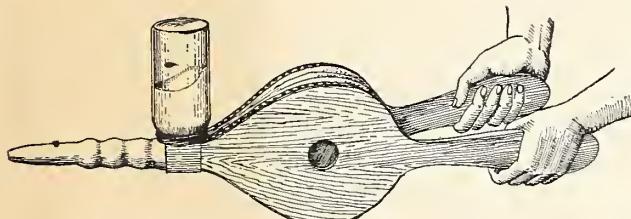


FIGURE 6.—Simple bellows type of duster.



FIGURE 9.—An ordinary medicine dropper used to inject oil among corn silks for earworm control.

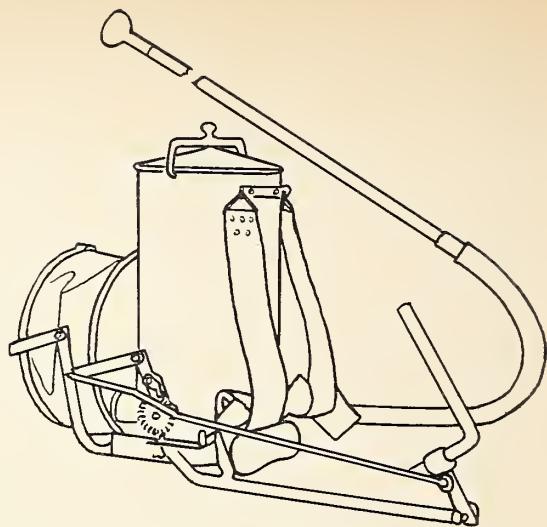


FIGURE 7.—Knapsack-bellows duster.

Fan or blower type of duster.—The fan or blower type of duster (fig. 8) is a satisfactory piece of equipment for both small and large areas. The knapsack-bellows and fan types of dusters are priced much higher than the small plunger and fireplace bellows types, but from the standpoint of efficiency of application and long-time service they are a good investment.

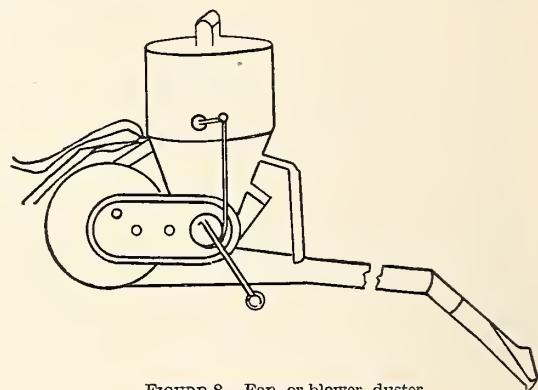


FIGURE 8.—Fan, or blower, duster.



FIGURE 10.—Protective devices: Left, a collar of cardboard will keep cutworms away from plants. Right, a tar paper disk placed around the base of each cabbage plant will aid in maggot control.

